AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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For Sale Everywhere by Newsdealers.

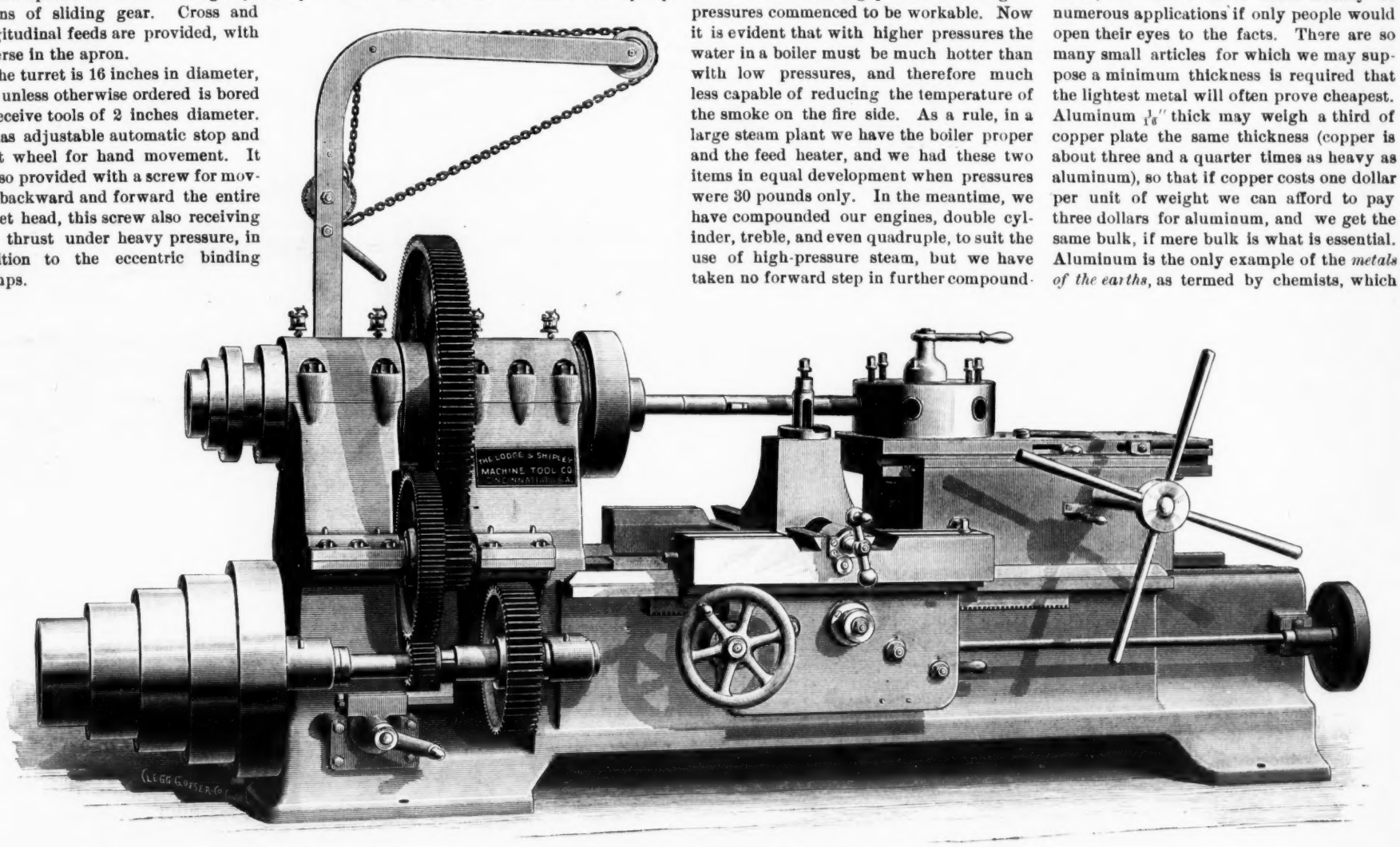
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Thirty-seven-inch Turret Lathe.

We illustrate with this a powerful turret lathe built by The Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

The lathe swings 37 inches and has a 10 foot bed, the bed and headstock being cast in one piece. The front bearing is 9 inches diameter and 13¼ inches in length; back bearing 8$\frac{13}{16}$ inches diameter and 12 inches long, oil wells being provided for self-lubrication. The change is made from one range of slow speeds to another of high speeds by means of sliding gear. Cross and longitudinal feeds are provided, with reverse in the apron.

The turret is 16 inches in diameter, and unless otherwise ordered is bored to receive tools of 2 inches diameter. It has adjustable automatic stop and pilot wheel for hand movement. It is also provided with a screw for moving backward and forward the entire turret head, this screw also receiving end thrust under heavy pressure, in addition to the eccentric binding clamps.



THIRTY-SEVEN-INCH TURRET LATHE.

A full-swing rest is furnished that will hold two tools, and is attached to the tool-block so that power feed may be employed as in cutting down two sides of a wheel at once.

Boring bars will pass through the core and take a bearing in a thimble which forms a guide for getting straight holes.

The lathe is furnished with complete countershaft, and weighs, boxed ready for shipment, 9,000 pounds.

According to Captain Mollard of the French Military College at St. Cyr, in 1892 Europe was supporting in productive idleness, as soldiers, more than twelve and one-half millions of able bodied men. His estimated strength of European armies in 1900 is twenty-two and one-half millions. Still people account for the unenviable condition of the workingmen of Europe by everything but this. Large armies and navies mean small pay for workingmen.

Materials of Engineering.

BY W. H. BOOTH.

Probably every reader of the AMERICAN MACHINIST (even the youngest of them) can look back and trace some change in the materials of which are made machines and engineering constructions generally. In steam machinery we have seen repeatedly how a rise in pressure and an improvement in the quality of boiler plates have gone hand in hand, so that we cannot exactly say that this one is the cause, and that the effect for both are at the same time both a cause and an effect. In my own recollection a good stationary boiler pressure was 30 pounds, and 50 was looked on as quite a serious matter, and older men who took up with such a pressure were inclined to think that they must be still quite young, or they would not dare to be so risky. In those days the large shafts of the big mill engines were of cast-iron and worked exceedingly well. Indeed, they were far better than either wrought-iron or steel in the way they worked up to a fine bearing in the brasses. It was customary to cast them vertically in a pit, the mold being rammed all round for support, a large head for pressure and as a dirt receiver being always added. The result was an excellent, fine-grained shaft, but the mischief with them was that they failed without warning and began to be discredited, so that they were replaced by wrought-iron, and often, too, without waiting for their breaking first, whereby much additional damage was avoided. Not merely the crank-shafts, but the central gudgeons of the beams of these engines, and also the smaller pins, would be of cast iron. It was natural that cast-iron shafts should disappear about the time that steel boiler plates came in. But the boiler was not waiting so much for a new material as for a different style of furnace, which it obtained in the shape of various forms of flanged joints and corrugated and ribbed plates, and these seem to be the starting point whence higher pressures commenced to be workable. Now it is evident that with higher pressures the water in a boiler must be much hotter than with low pressures, and therefore much less capable of reducing the temperature of the smoke on the fire side. As a rule, in a large steam plant we have the boiler proper and the feed heater, and we had these two items in equal development when pressures were 30 pounds only. In the meantime, we have compounded our engines, double cylinder, treble, and even quadruple, to suit the use of high-pressure steam, but we have taken no forward step in further compounding the process of making steam. I have known the waste heat of furnaces used up more or less by boilers 60 feet in length, in which, if the circulation was at all good, there must have been an even temperature throughout, and have always thought how very much better, safer and more economical it would have been to have used two boilers of half the length, and passed all the water through one to the other, so having a length of 30 feet of comparatively cold boiler to better absorb the heat from the gases partially cooled by the hotter portion or boiler proper. The more modern tendency is towards shorter boilers and a second water heater in the flue. But often I have found the heater to be as hot as the boiler, and the smoke going to waste at too high a temperature, as though demanding a still further extension of the compound principle.

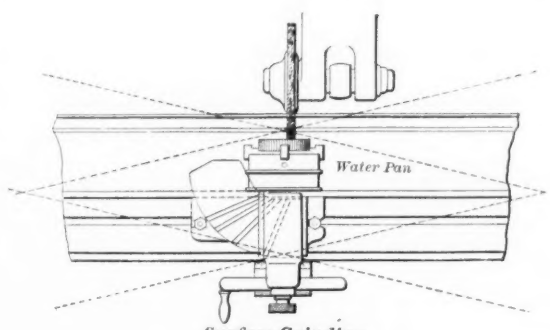
The new metal, aluminum, is getting cheaper, and, being very light, it is really very much cheaper for its bulk than its price indicates, if we do not correct our natural impulse to regard it as heavy as brass or copper. It is quite considerably sold about England in the shape of thimbles for 4 and 6 cents, and ash trays at 24 cents, and ornamental articles, such as vases and flower-stands, and I have seen tubes made from it. It is used cast as well as in stamped goods. Aluminum has been probably vastly overrated as a material for heavy structures, as bridges, etc., but this is no fault of the metal, for which there must already be numerous applications if only people would open their eyes to the facts. There are so many small articles for which we may suppose a minimum thickness is required that the lightest metal will often prove cheapest. Aluminum $\frac{1}{16}''$ thick may weigh a third of copper plate the same thickness (copper is about three and a quarter times as heavy as aluminum), so that if copper costs one dollar per unit of weight we can afford to pay three dollars for aluminum, and we get the same bulk, if mere bulk is what is essential. Aluminum is the only example of the *metals of the earths*, as termed by chemists, which exists in large quantity. Of the metals of the alkaline earths there is calcium, whose specific gravity is little above half that of aluminum, and which is also a very difficult metal to reduce, besides having a greater tendency to oxidize, so much so as to easily decompose water. There is, of course, an enormous amount of calcium in the world. The city of London stands on about 300 feet in thickness of aluminum oxide, which in turn rests on a still greater thickness of calcium carbonate. Aluminum, though light, is nearly five times heavier than the lightest metal of somewhat similar kind, namely, lithium, but all the other metals of the earths and alkalies are marked by their too great combustibility, of which property the photographer avails himself in magnesium, whence he obtains his flash light. Aluminum alone seems to be useful for mechanical purposes, and it does not, I am informed, combine with mercury, but there does not seem to be a field for it either in quality or

price as the substitute for iron. In alloys we have many more to choose from than formerly, such as Delta metal, phosphor bronze and ajax metal, and the composition of true alloys, as distinguished from mere mechanical mixtures, is better understood. We may suppose all alloys to be mechanical and not chemical compounds, but there is an essential difference between an alloy of two metals in which each metal fills the voids of the other, and a mixture in which one metal is too small in quantity to fill the interstices. In the latter case a vertically cast bar might be a true alloy at one end and consist of one metal only at the other end. The true alloy resembles in a sense a pailful of coarse sand, into which water has been poured. No water appears on the surface until all the vacancies are filled, and as soon as the surface is wetted any further supply of water remains above the surface. This resemblance, however, is partial only, for we may take the copper-tin alloys and note that though some of them are heavier than copper, many of them are lighter, and the heavier are not thereby the stronger, and this shows us that some alloys, the softer metal squeezing out like water from a sponge.

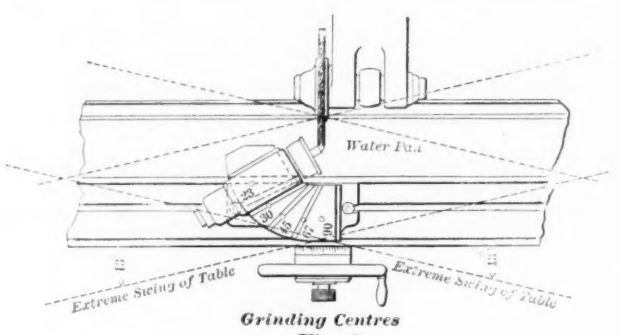
Surprise may well be expressed as to how people engaged in new industries would have lived but for their development. Ten years ago there were but few people living out of the electrical business as compared with to-day. Electricity has been almost like a new material. Old as are what we may term the laboratory phenomena of electricity, it is the invention of the dynamo which has rendered possible all the modern developments, and it is to electricity we owe cheap aluminum. Whether it will be due to direct steam or to electricity the next great move seems to be in the direction of much more rapid traveling. The first full-sized railroad to be electrically operated has been opened. An electric motor lacks one undesirable feature which is present in the steam engine—it has no reciprocating parts, and is in perfect rotative balance. There is no limit to velocity short of strength to resist bursting stress. In this country there is a good deal of discussion as to the means to be employed to convey electricity to the moving car, whether by the American system of overhead conductor, the underground conduit with slot as usual with cable roads, or by accumulator batteries. The overhead conductor is objected to here on the ground that telegraph poles are tabooed the streets, but otherwise it has undoubted advantages. Somehow, to steam men, electrical traction has not the attraction possessed by the self-contained locomotive, which can carry many miles of energy in the shape of a ton of coal, and can pick up water as it runs. With liquid fuel this also could easily be picked up when running, and the long distance endurance of the steam motor made equal to that of the electric motor.

There has to come a struggle between stationary and locomotive steam engines once more, for after all electricity is only a mode of communicating power from a stationary engine. The problem of fitting a freight yard with electricity is too appalling to be seriously considered at present, and, until a better mode of picking up current is devised, electricity seems likely to be confined to straightforward work only.

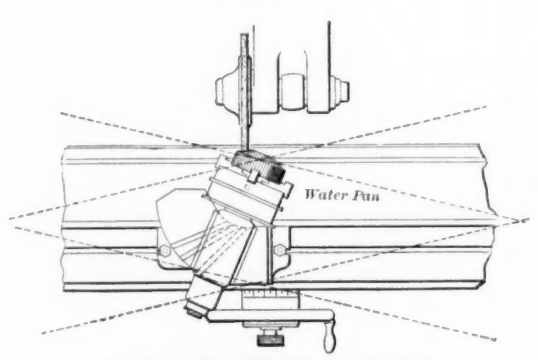
There has been recently circulated a little paragraph dealing with the so-called difficulties of the English system of weights and measures. I suppose it is due to the efforts of the Metrical Association. It deals with the very various measures and weights by which articles are sold, and the different values which a measure of the same name possesses in different localities, or when applied to measure different articles. It is pretended that all these measures are crammed down children's throats at school, and the system is described as brain-destroying, and so on. Now I went to school myself once—this is a fact, however unapparent it may be in some of my effusions—but I have no recollection of learning anything like the quantity of different measures which even the short paragraph contains, and though I don't uphold these measures, I fancy such wild statements do not help on the cause of the decimal system.



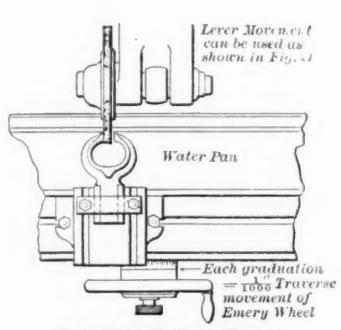
Surface Grinding
Fig. 7



Grinding Centres
Fig. 8



External Angular Chuck Grinding
Fig. 9



Grinding Caliper Gauge
Fig. 10

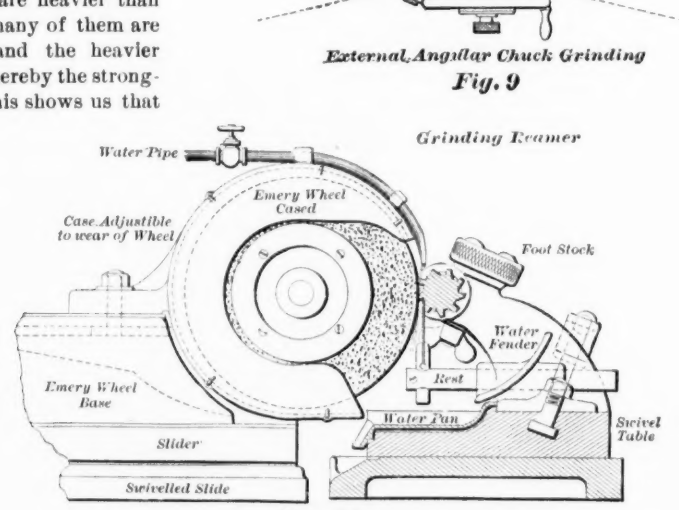


Fig. 11

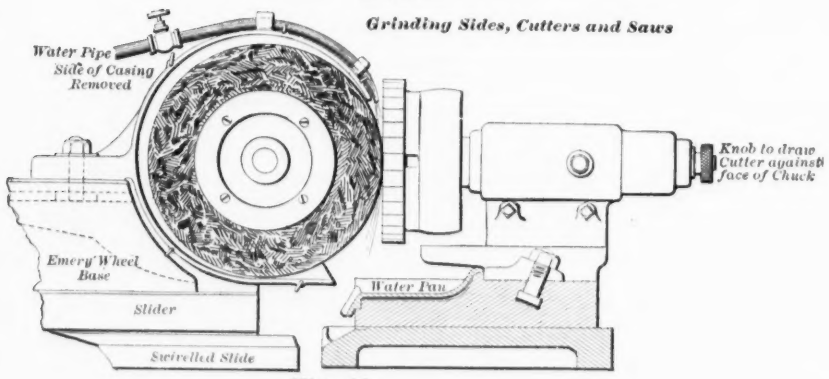


Fig. 12

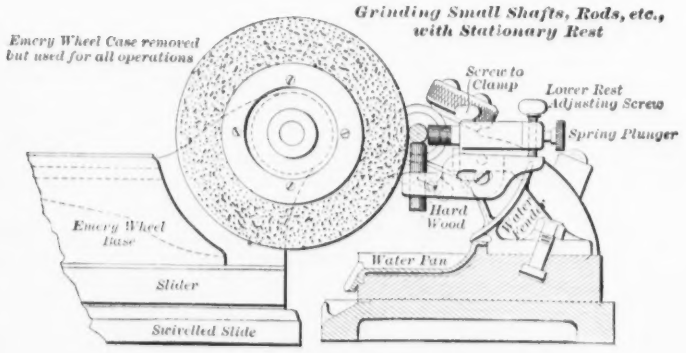


Fig. 13

Top View Plain Shaft Grinding

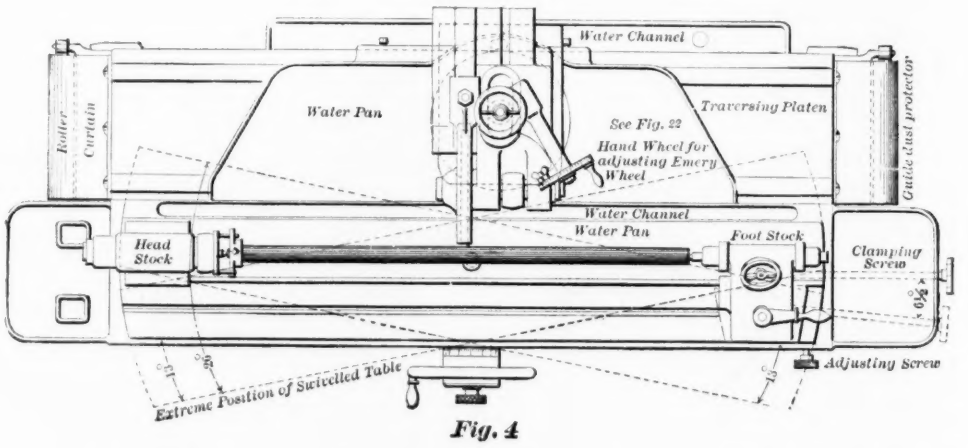
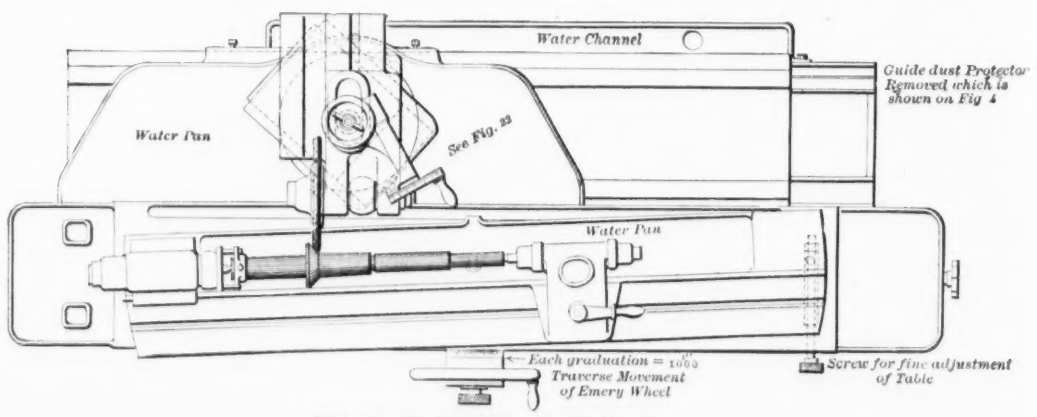


Fig. 4


Water Channel
Guide dust Protector Removed which is shown on Fig. 4
Water Pan
See Fig. 22
Water Pan
Each graduation = 1/1000 Traverse Movement of Emery Wheel
Screw for fine adjustment of Table

External Angular Grinding
Fig. 6

Operations Performed on Universal Grinding Machine —See Page 3.

the added tin has done something more than merely fill the voids in the copper, for had it done this simply the specific gravity would have been greater. Just whether alloys are chemical or mechanical in composition seems to be uncertain; some undoubtedly are mechanical only, for heavy pressure will separate the constituents of

At school I was familiar with the ordinary British measures of the pound and foot and gallon; at college I became so familiar with the metrical system that I had no use for pounds and feet, excepting in the class on mechanics, but I never found any difficulty in regard to knowing two sets of measurements, and never confused them. In business, British measures have ordinarily served me, and I did not know, until considerably over 20 years of age, that the old wine gallon of $8\frac{1}{3}$ pounds was still used in America, this fact being taught me by reason of my inability to figure the contents of the tender of a locomotive as anything near that claimed for it by the representative of its American makers. When working in France, of course I used the metrical system, but the French people don't use it at all universally, and I have been asked so many *sous* per *livre*, and in Holland, where the metrical system is used, or supposed to be, it is not universal, and even when the kilogramme is mentioned by the people it is in the way of so much per half kilogramme, the half kilogramme seeming to be rather the unit of weight than the kilogramme itself. Indeed I have heard the expression a "quarter of a half kilogramme." All this seems to point to the fact that the decimal system is not one generally comprehended of the people; they prefer halves, quarters, eighths, etc., and how familiar is the use in America of the word *quarter* when 25 cents is meant. After so many years, too, it seems strange to find the term penny and shilling used in the United States, the shilling in different localities varying from half to one and a half English shillings. I do not think this question of weights, measures and money has nearly so many difficulties as some would have us suppose, nor do I think that a decimal system will ever prove as convenient as would a universal duodecimal system. How many readers of the AMERICAN MACHINIST know what a "floor" is, or to what it is applied? It is purely a local term in England, so far as I have been able to learn, and is used by the fenmen as a measure of excavation and embanking. Its value, in more familiar measure, is 400 cubic feet. It is said there is a danger of trade being lost by this country because we do not use the metrical system. If trade is being lost, I do not think it due to this cause, for I have never heard of any difficulty experienced in the workshops on this account, and it is common enough for a set of drawings to go into the shops of a locomotive factory figured in millimeters, and to be worked to by the machinists. Indeed, how could a machinist very well go wrong if supplied with a meter rule? It would be wise in all iron manufacturers to send out their section books figured in millimeters, but that they do not do so is no absolute bar to business, for I have noticed in Holland that drawings figured generally in millimeters would have the angle irons figured in inches, thus $2''x2''x\frac{3}{8}''$, being merely copied from the section book of the English rolling-mills.

There appears to be a prevalent notion that a man's head will hold just so much knowledge and no more, and that did we but learn one set of measures we should have left more room in our heads for other knowledge, whereas the opposite is the fact—the more we acquire of knowledge the greater will be our capacity for further acquisition.

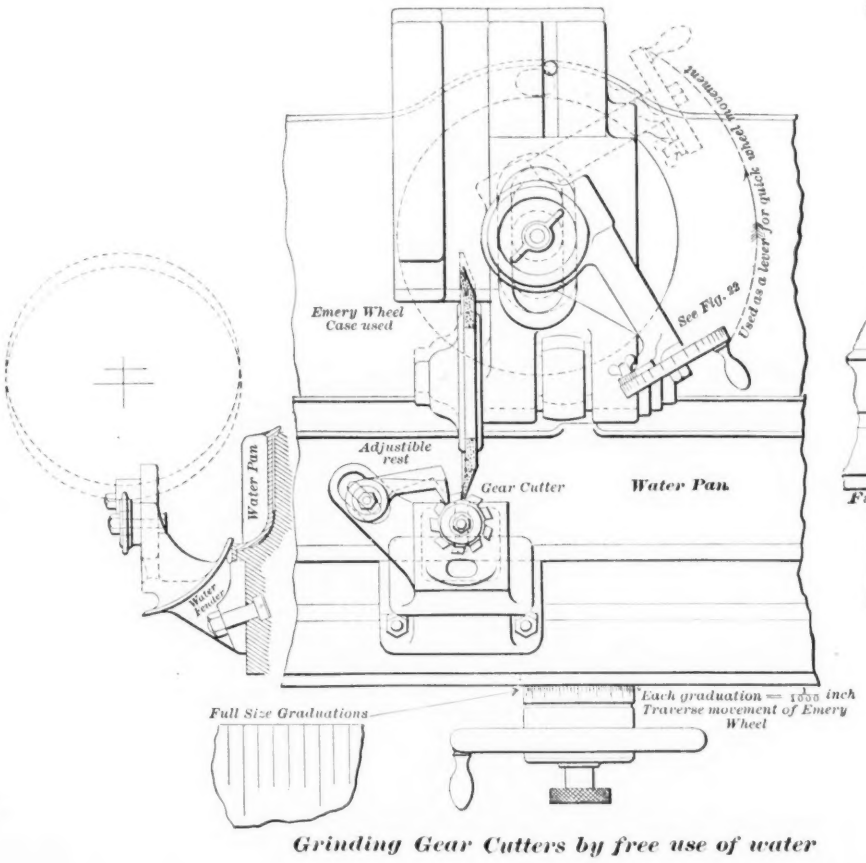
While on the subject of cast iron for machinery spindles, I conclude this is often used because of the excellent manner in which a cast-iron shaft will run in a cast-iron bearing, and in some of the parts of cotton machinery it is customary to encircle wrought iron high-speed shafts with cast-iron collars, simply because of the better running of these in cast iron bearings than can be obtained with wrought-iron or steel or gun metal.

The Inventor of the Bicycle.

"The popular belief is that the bicycle is a modern invention, when, in fact, it really dates back to the seventeenth century," said Dr. T. C. Minor. "I learned this one day when I was making some translations from the *Journal de Medicine de Paris*. Ozaram in 1694, in his 'Mathematical and Physical Recreations,' tells of a carriage, as he calls it, 'in which one can ride without the use of horses.'

"And then he goes on to tell of how a lackey sits at the back, makes it run by 'walking alternately with his two feet by means of two small wheels concealed in a case just between the wheels behind and attached to the axle of the carriage.' This was the principle of the velocipede, so much improved since then. But the priority of the discovery of the bicycle I believe to be established without further argument or dispute.

"It was by a physician, Eli Richard, a young physician of Rochelle, France, who made the first machine after which our modern bicycle is patterned. He was a medical student in Paris in 1666 and became one of the great physicians of France. He died at the age of 61, at Rochelle, in 1706, and there is a street in Rochelle named for him; and there is now a movement on foot to erect a bronze statue, not to Michaud, who it is claimed was the discoverer of the bicycle, but to the true discoverer, Dr. Eli Richard."—*Cincinnati Times-Star.*


Emery Wheel Case used
See Fig. 22 Used as a lever for quick wheel movement
Adjustible rest
Gear Cutter
Water Pan
Water Pan
Water Jacket
Full Size Graduations
Each graduation = 1/1000 inch Traverse movement of Emery Wheel

Grinding Gear Cutters by free use of water

Fig. 21

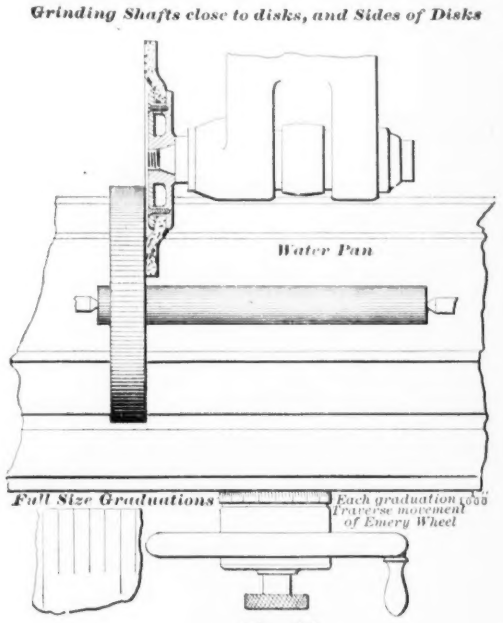

Grinding Shafts close to disks, and Sides of Disks
Water Pan
Full Size Graduations
Each graduation 1/1000 Traverse movement of Emery Wheel

Fig. 16

Operations Performed Upon the "Landis" Universal Grinding Machine.

In our issue of August 3, we published engravings showing the construction of the universal grinding machine built by Landis Brothers, of Waynesboro, Pa., and we now present other engravings showing its adaptation to certain kinds of work and the method of operation.

Fig. 4 is a plan view of the machine as arranged for plain shaft grinding, the dotted lines drawn upon it showing the extreme position of the swiveling platen when arranged for taper or angular work.

At Fig. 6 is shown the method of grinding such a journal as is there indicated composed of two separate conical portions, the platen being set for one of these while the wheel slide is set to the proper angle for the other, this last setting being, of course, the sum of the two angles measured from the center line of the shaft.

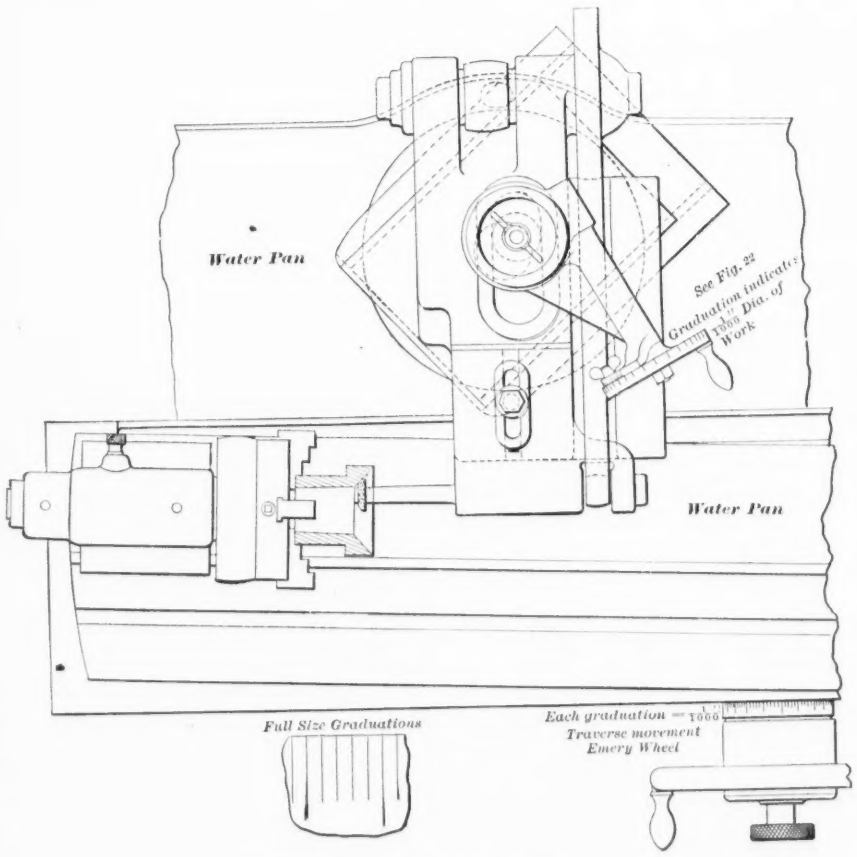
Fig. 7 shows the use of the grooved block for face grinding, the dotted lines indicating the angles to which it can be set without disturbing its position on the platen, while Fig. 8 shows the method of grinding centers by the same block, Fig. 9 angular grinding, and Fig. 10 gauge grinding by a special block.

Figs. 11, 12 and 13 explain themselves, and show how various kinds of grinding are done, water being conveniently used for all of them.

At Fig. 14 is shown the method of grinding a box for such a journal as is being ground in Fig. 6, the setting of the wheel slide being, in this case, the difference between the two angles of the different conical portions of the box measured from the center line.

Fig. 15 shows the method of grinding shoulders, and Fig. 16 a similar operation, in which the radial surface is larger, and the shaft may require to be ground close to it.

Fig. 21 gives the method of grinding


Water Pan
See Fig. 22 Graduation indicates 1/1000 Dia. of Work
Water Pan
Full Size Graduations
Each graduation = 1/1000 Traverse movement Emery Wheel

Internal Angular Grinding

Fig. 14

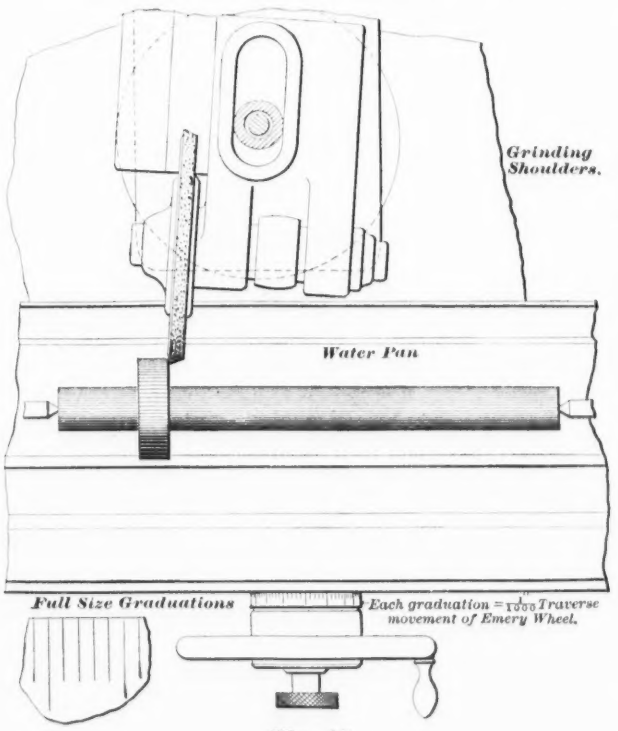


Fig. 15

OPERATIONS PERFORMED ON UNIVERSAL GRINDING MACHINE.—SEE PAGE 2.

B. & S. gear cutters, indexing them to get the teeth uniform, and moving the wheel to and from the work by means of the lever movement referred to last week, and plainly indicated on the engraving. Water can be freely used for this. Other operations and the method of performing them upon the machine will, of course, readily suggest themselves to mechanics.

Columbian Exhibition Notes—XII.

Editorial Correspondence.

The Long & Allstatter Co., of Hamilton, O., have in their space a number of heavy punching and shearing machines suited to various different classes of work, the most novel of these being a double angle iron shear, the base of which is circular in form and is a complete turn-table, a vertical shaft coming down from the countershaft to drive it by means of bevel gears. This ver-

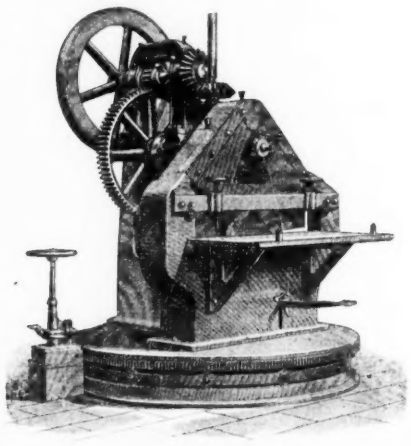


Fig. 61.

tical shaft is exactly above the center of the turn-table at the base of the machine, and thus by means of a hand-wheel the machine can be turned to any desired position. The object of this is to be able to cut long bars at both ends at any angle without the necessity for removing them from the machine and turning them around, this in some shops being a very difficult thing to do if not impossible. The machine, with the casing removed which ordinarily covers the anti-friction rollers, is shown in Fig. 61. The machine exhibited will cut angle iron or steel up to 7″x7″ and ⅞″ thick, at any angle up to 30°.

In addition to this there are four other machines, including a gang punch 72″ wide which will punch 36 ⅝″ holes 2″ apart, through ½″ plate at one stroke; a boiler punch for the heaviest work up to 6″ flue

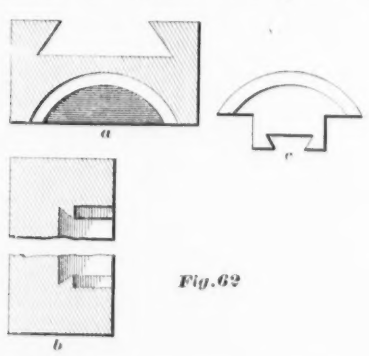


Fig. 62

or hand holes in ⅞″ plates; a smaller machine for boiler work which was used in the construction of some of the World's Fair buildings, and has punched about 500,000 holes; a heavy horizontal punch for channel, angle-iron and flange work. The machines are all shown in operation and constitute a fairly representative lot of the machinery built by the L. & A. Company, though not as heavy or powerful as many of the machines turned out by them.

The Jones & Lamson Mach. Co., of Springfield, Vt., show two screw machines and one of their flat turret lathes. The latter machine, though known to our readers, having been illustrated and described in our issue of May 7, 1891, is yet relatively new and attracts much attention among machine men. The machine as shown is essentially as it was when we illustrated it, except that it has a sliding bar at the back, the same as a Fox lathe, this bar having clamped to it an arm which carries a die holder in which is a solid die, the holder having the usual knock-off arrangement. The arm is swung into position when the die is wanted and at other times is back out of the way. It simply adds one more to the

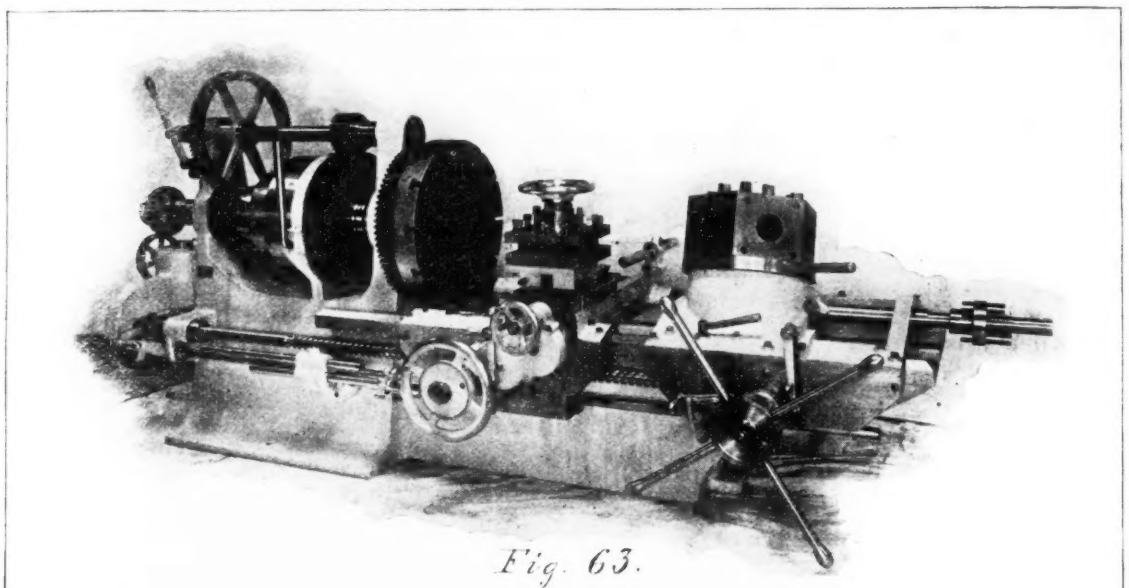


Fig. 63.

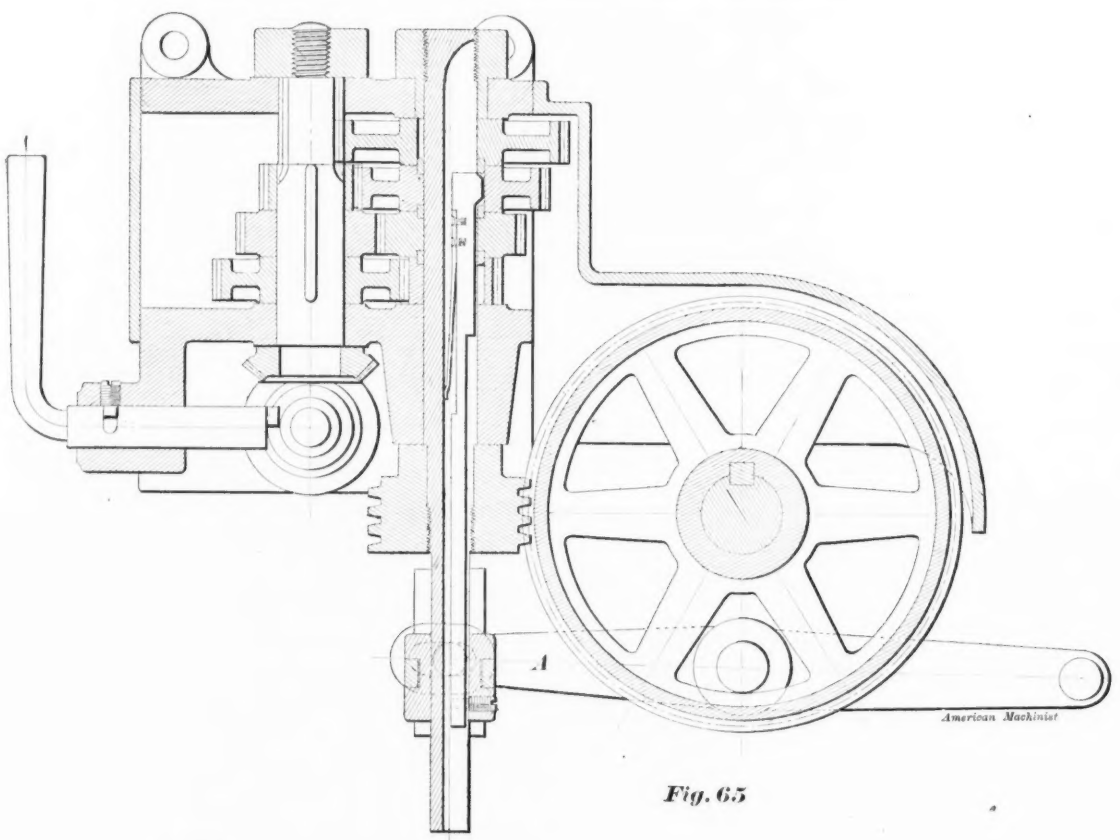


Fig. 65

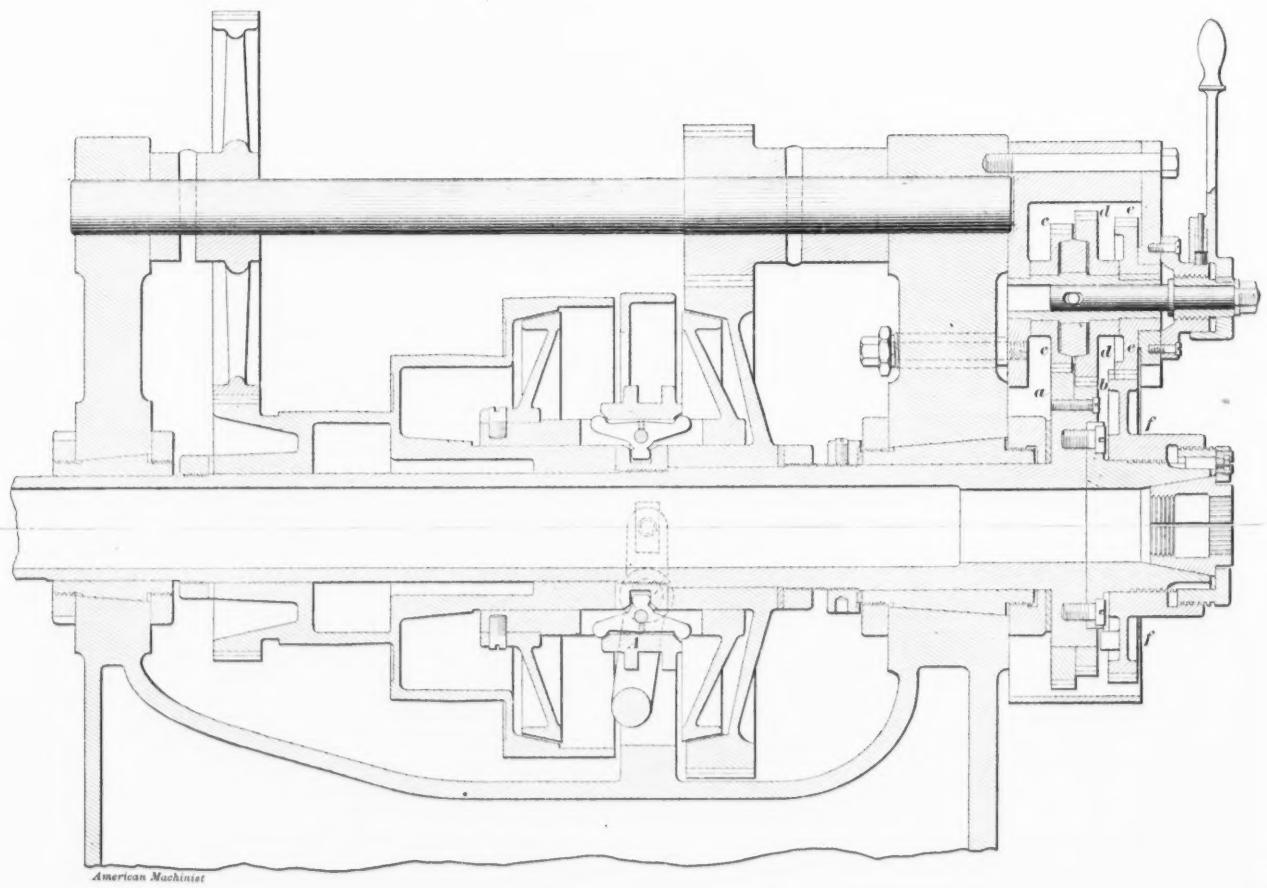


Fig. 64

number of tools that can be used upon a piece of work with a given number of holes in the turret. Still another addition is made to this number by the use of a stop which is at the end of an arm pivoted in front of the bed so that it can be swung into position when wanted, and used for gauging the length of work in place of the stop which would otherwise be required in the turret. All the machines are shown in operation.

The exhibit of the Niagara Stamping and Tool Company, of Buffalo, consists mainly of tinners' and sheet metal workers' bench and other small tools, there being, however, a few belt-driven machines such as double seamers and other machines used in sheet metal manufacturing operations.

The Buckeye Iron and Brass Works, of Dayton, O., besides a fine display of finished brass work and fittings, show two machine tools which have been designed for use in their own shops, one of these being a forming lathe with a vertical slide constructed on much the same principle as one we illustrated some months ago, but, in addition to the usual lever for moving it, there is an automatic feed, by means of a feed rod, which runs along at the back of the machine and by bevel gears, and a vertical shaft, upon which is a worm, drives a worm sector that moves the slide. The worm is thrown in and out of action by a small eccentric.

A new and evidently very good way of adjusting the forming tool to cut one end of the work smaller or larger is to be seen on this machine, the principle of it being shown by the sketch, Fig. 62; in which *a* is a horizontal cross-section of the vertical forming tool slide; *b* a vertical cross section and *c* a plan of the block which holds the tool. It will be seen from this that there is, in the face of the slide, a circular recess formed which has, at top and bottom, dovetails which engage with corresponding dove-tail surfaces at the top and bottom of the adjustable block. The result of this arrangement is that the block can be inclined either to the right or left as may be desired, and a vertical clamping bolt, which presumably enters a loose clamping piece at the bottom, holds it securely in any position. There is a similar loose clamping piece at one side of the dovetail at *c* in which the tool is placed; neither of these pieces being shown on the sketch since they will be readily understood.

The other tool shown by this company is for milling the squares or hexagons on brass cocks, valves, etc. It uses as many milling cutters as there are sides to the work to be milled, and these all cut simultaneously, making it, with the facilities which it offers for putting in the work and removing it from the machine, very efficient.

The Gisholt Machine Company, of Madison, Wis., have some of the most novel machine tools to be seen here. Among them is their universal tool grinder, which was illustrated in these columns June 4, 1891, since which it has been improved, though retaining its main features as at that time.

At Fig. 63 is shown a machine which is typical of a full line of such machines that are exhibited by them. Lack of space will not permit me to go into details regarding this machine to the extent that its merits and novel construction deserve, but by reference to this Fig. 63, and the sections, Figs 64, 65, 66 and 67, its construction and method of operation will be readily understood.

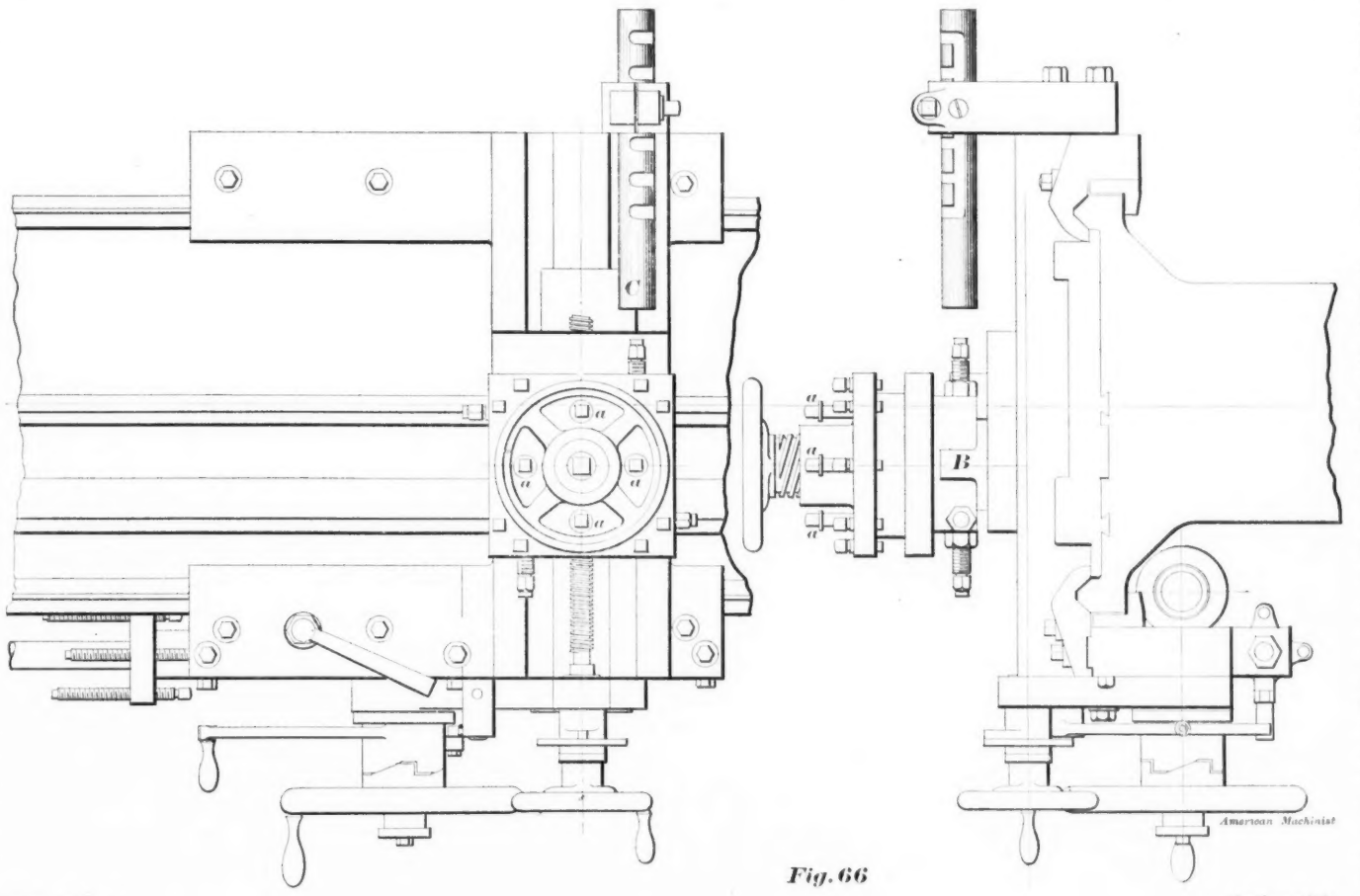


Fig. 66

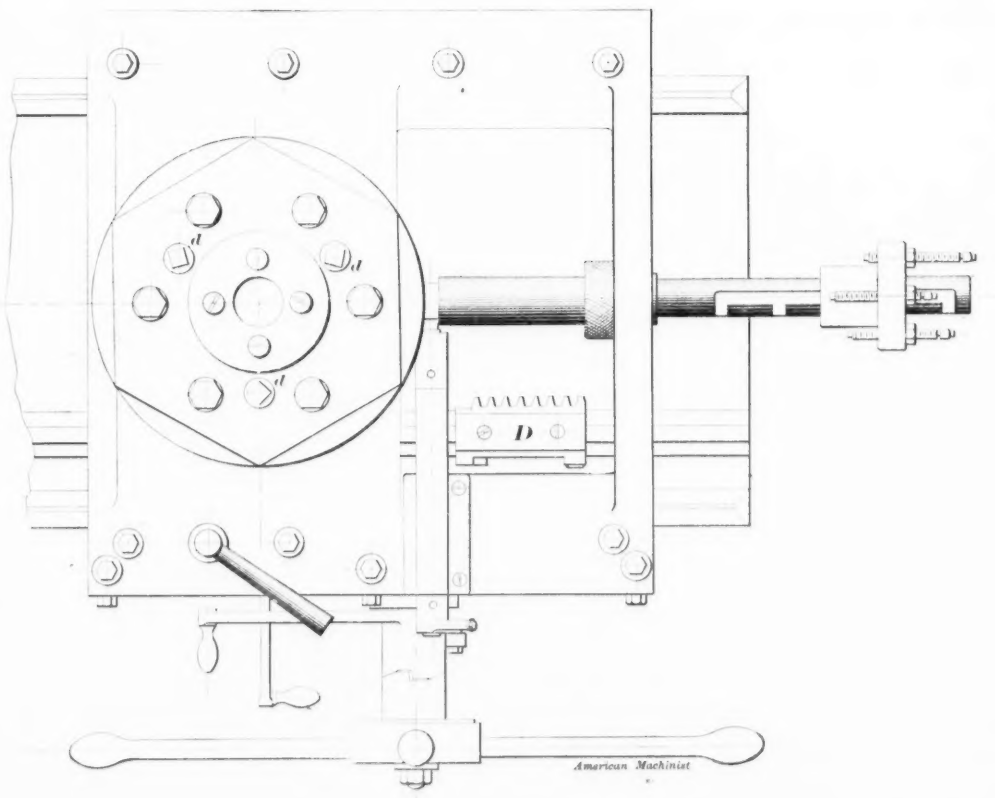


Fig. 67

Fig. 63 is the largest and heaviest machine exhibited, having a swing of 30″; traverse of turret of 54″, with a 4½″ hole through the spindle, and 4″ holes in the turret. It will be noticed that it has a geared face-plate, while the detail drawings show a smaller machine with automatic chuck on the spindle, the two machines being, in most of their essential points, alike, however, so that all the figures may be studied together.

Fig. 64 is a section of the head showing the friction clutch and automatic chuck. The former is handled by a lever outside which operates to move the collar *A*, this collar moving the two rocking levers seen inside of it above and below. These in turn move the sliding sleeve upon which the male cones are placed, the one which engages the large gear being solid with the sleeve.

Upon the main collar of the spindle outside the main bearing there are two small spur gears *a* and *b* which engage with companion gears *c* and *d* above. These latter run loose, and between them there is a double friction disk, which is moved by the lever outside and the threaded sleeve as shown. Thus either of these gears may drive the gear *e* which engages with the gear on the sleeve *f*, which latter may therefore be driven at two different speeds or stopped according to the position of the vertical lever.

When the clutch disk is thrown to the left sleeve *f* will revolve faster than the spindle, while if it is thrown to the right the motion of *f* will be slower than that of the spindle, and the spring collet will accordingly be opened or closed, depending upon the position of the lever, the force with which it will be closed depending upon the force with which the lever is moved. When in the middle position the gear on the sleeve *f* drives the others and the chuck is not affected.

Fig. 65 shows the mechanism for driving the feed rod, the two vertical shafts having gear cones and the sliding key being moved by the lever *A* to change the rate of feed. The transmission from the second vertical shaft to the feed rod is by the worm and wheel as shown.

Fig. 66 is a plan and end view showing the carriage, which, as will be perceived, has a new form of tool-post that holds four tools in such a manner that any one of them may be quickly brought into position, and they are separately adjustable vertically and horizontally without loosening them. The square grooved block which holds the tools, one upon each of its four sides, is moved vertically by the central multiple-threaded screw, so long as any one of four rectangular notches at the bottom of the block are engaged with a single lug *B* on the slide; but as soon as the block is raised above this lug it turns with the screw and can then be run down again with the succeeding tool in position, the vertical position of the tool when at rest depending upon the adjustment of the corresponding set-screw *a*, these set-screws successively resting upon the lug *B* and forming the stop for the descent of the tool-post. On each of the four side faces there are set-screws also as shown, these in turn being brought against the stop *C* at the back which is adjustable and grooved as shown so that it is positively held, a lengthwise groove giving facility for adjustment. The four set-screws seen at the left of the carriage come against a similar stop and thus limit the travel of the carriage, their first action being to automatically throw out the feed.

At Fig. 67 is a plan view of the turret, its slide also moving direct upon the bed the same as the carriage. The distance to which any one of the tools shall be advanced is in this case also separately adjustable by means of the set-screws seen at the right, which for quick and approximate adjustment are in a head which is movable upon the rod. The stop against which they come is adjustable upon the bed of the machine, and the first action is, like the other, to release the feed, after which the turret can be moved up until positively stopped. The turret is revolved by a rack and pinion movement, the short rack *D* being adjustable along the bed for that purpose, and things are so arranged that by running down any one of the set-screws *d* the turret is automatically turned two holes instead of one, when this set-screw acts upon the releasing catch, the other movements of the turret being as before, while by reversing all the screws *d* down the turret will be always moved two holes instead of one.

The machines are shown in operation on such work as heavy studs made from the bar, and in finishing gear blanks, these being done in screw machine style, rapidly and well. In fact, about the only limit which Mr. Conradson, the designer of the machines, seems willing to place upon their usefulness refers to the number of pieces alike which are required, not to the size or weight of the pieces. When I last saw him he was talking with a prominent locomotive builder, and offering to turn some sample locomotive crank-pins to show what could be done with the machine. Six of the machines, varying in size and somewhat in certain features, are shown, the collection showing their adaptability to a very large range of work, small screws, studs, bolts, and such work as is generally recognized as screw machine work, being at one end of the line, while cone pulleys and back gear blanks for 30″ lathes are at the other, along with much else besides that is not generally supposed to be manageable except by the regular methods, which, of course, it is not, unless considerable numbers of pieces all alike are to be made.

Beaman & Smith, of Providence, R. I., exhibit representative specimens of their machine tools, the milling machine in various forms being prominent among them. They show one machine of the single column, knee and overhanging arm type, in which there is a slide on top of the column below the spindle by which the spindle may be moved in a direction parallel to its length, thus doing away with the cross-slide on top of the knee and making that portion of the machine more compact than it otherwise would be. The machine is intended for heavier work than is usually done on machines of this type, and is very heavy and powerful. Other forms of the milling machine are of the planer type, with housings on both sides of the platen and also with only one housing, the arm overhanging.

They show two different forms of horizontal boring and drilling machines—one of the Bement type, the other with the large fixed platen near the floor and supporting two upright movable posts upon which are the saddle and outboard bearing for supporting the spindle and boring bar. They also show, assembled and in parts, their tapping device, which we illustrated in our issue of November 12, 1891.

The Jarecki Manufacturing Co., of Erie, Pa., show a full line of pipe-cutting and threading machines driven by hand, belt, attached engine, and by electric motors, their machines being neat in design and well arranged, with open dies adjustable by worm and wheel, and with graduations to indicate proper setting, there being also a very convenient stop for use when a number of threads of the same size are to be cut. A dozen or more machines are shown, adapted to cut and thread pipe from ¼″ to 12″ diameter.

The Armstrong Mfg. Co., of Bridgeport, Conn., also exhibit pipe fitters' tools, their exhibit being mainly of the smaller hand and bench tools. They show, however, four power driven machines for cutting and threading pipe up to 6″.

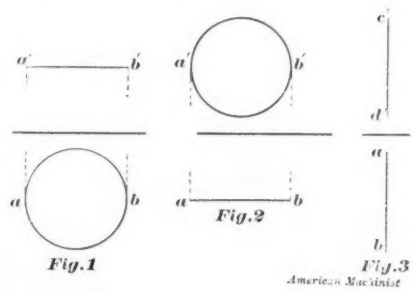
They call particular attention to a nipple holder which they declare enables the pipe fitter to escape much grief. It consists of a tube which is threaded internally at both ends with pipe taps, so that either end will receive the threaded end of a nipple. One end being for a certain size, the other is for the next size larger. In the middle of the length of the tube is a slot passing through from side to side, and in this is a taper key which is made like a connecting rod key, and serves to hold a plug which is put in loose in the tube. When one end of the nipple has been threaded it is screwed into this tube until it comes into contact with the plug, which is held up by the key. The other end is then cut and the key driven back, after which the nipple comes out easily, instead of being ruined in the effort of taking it out, as is too often the case, by the usual methods. What seems somewhat curious about this to the tool maker is that so obvious an arrangement should not have been used by pipe fitters since nipples were first made. Machinists have for years used a device made upon the same principle for putting in studs, this being simply a piece of hexagon steel tapped clear through to fit the studs, and having in one end a set-screw against which the end of the stud comes while being screwed, said set screw, upon being loosened, making the stud perfectly free.

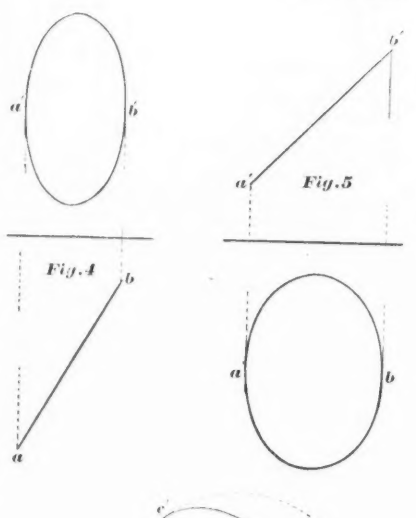
The Capitol Mfg Co., of Chicago, have an interesting exhibit of bolt cutting and nut tapping machinery, the latter consisting of one of their "Cook" automatic nut tapping machines of the smallest size which is shown at work tapping ¼″ nuts at the rate of 30,000 per day and requiring no attention whatever except to keep the hopper filled with blanks, the machine being something of a revelation to those who are not readers of the American Machinist, where it was illustrated and described in issue of October 27, 1892.

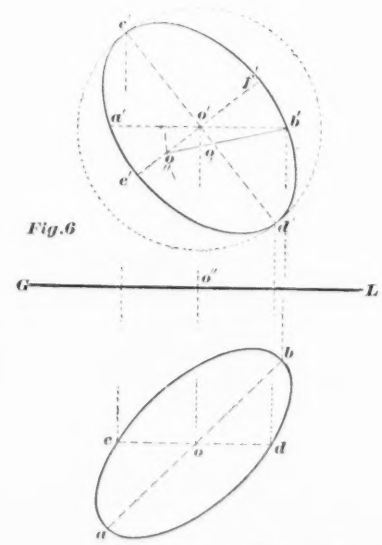
The rest of the exhibit consists of two double head and three single head bolt cutters having the "Adams" automatic head with open dies, one of these heads being the new "Cook-Adams" head, which is adjustable independently of the automatic opening and closing. Both forms of head are familiar to our readers, having been illustrated and described in our issues of April 25 and October 31, 1889, November 5, 1891 and June 30, 1892. The machines shown range in size from those suitable for cutting $\frac{3}{16}$″ bolts up to 3½″ bolts, the latter machines with specimens of their work atttracting much attention, especially from our foreign friends, who, it seems, are not accustomed to seeing bolts nearly so large cut with dies at a single cut; a number of them declaring it to be impossible until the machines are made to do it for them.

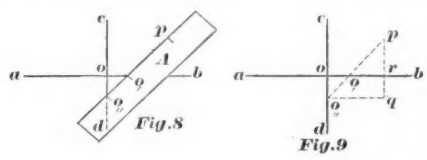
With the others is shown a new machine for cutting off and threading pipe up to 2½″. The machine has two heads, the spindle in one of them carrying a two-jaw universal chuck, while the other has an "Adams" head supplied with pipe dies instead of the usual bolt dies. Both the chuck and the die head are at the inner ends of their respective spindles, and between them is a movable carriage which has jaws for holding the pipe while being threaded, and a cut-off tool. Both spindles are hollow so that the pipe can be passed entirely through the machine. Either spindle is driven at will by means of clutches which are under the control of the operator. The Adams head seems well adapted to this work, and the machine is capable of turning out a great deal of good work of this character.

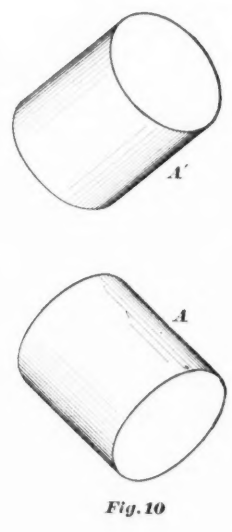
Jackson Park, July 31. F. J. M.

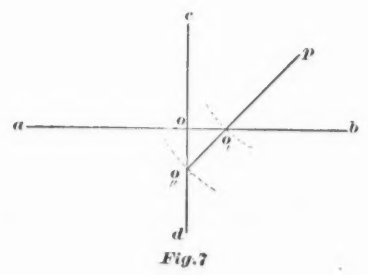












Projections of the Circle.

LETTERS FROM PRACTICAL MEN.

The Projections of the Circle.

Editor American Machinist:

In mechanical drawing a circle may be represented, (1) by a circle whose diameter is equal to that of the given circle; (2) by a straight line whose length is equal to the diameter of the circle; or (3) by an ellipse whose major axis is equal to the diameter of the circle; the length of the minor axis being dependent upon the inclination of the plane of the circle to the plane upon which it is projected.* These projections are illustrated in Figs. 1 to 5. Fig. 1 shows the plan $a\ b$ and elevation $a'\ b'$ of a circle whose plane is parallel to the horizontal plane.

Fig. 2 represents the plan $a\ b$ and elevation $a'\ b'$ of a circle whose plane is parallel to the vertical plane.

Fig. 3 gives the projections $a\ b$ and $c'\ d'$ of a circle whose plane is perpendicular to both horizontal and vertical planes.

Figs. 4 and 5 represent circles whose planes are perpendicular to one plane, and neither parallel nor perpendicular to the other plane.

With these positions of the circle the draftsman is familiar. I call attention to them in order to exhibit in one set of figures all the cases which can arise. Only one more is needed to complete the illustrations.

Fig. 6 illustrates the most general problem on the representation of the circle in mechanical drawing. It may be stated as follows: *Having given an ellipse which is the plan of a circle, it is required to construct the elevation, the center being a given distance from the horizontal plane.*

Let the ellipse $a\ d\ b\ c$ be the plan of a circle, the major axis $a\ b$ being drawn at any angle with the ground line $G\ L$. Through o, the center of the ellipse, draw $c\ d$ parallel to $G\ L$. Draw $o\ o''\ o'$ perpendicular to $G\ L$, making $o''\ o'$ equal to the given distance from the center of the circle to the horizontal plane. From o' as a center, with a radius equal to $o\ a$ ($= o\ b$), *i. e.*, equal to the radius of the circle to be represented, draw a circle. From c and d, respectively, draw $c\ c'$ and $d\ d'$ perpendicular to $G\ L$, intersecting the circumference of this circle at c' and d'. Draw $c'\ d'$ which will pass through o'. This line is the major axis of the ellipse, because it represents that diameter of the circle which is parallel to the vertical plane, and is therefore shown in its true length. This is evident, because the plan $c\ d$ is drawn parallel to $G\ L$. Through o' draw $a'\ b'$ parallel to $G\ L$. From b draw $b\ b'$ perpendicular to $G\ L$, intersecting $a'\ b'$ at b', the elevation of b. Since $a\ b$ is represented in the plan in its true length, it is that diameter of the circle which is parallel to the horizontal plane. Its elevation $a'\ b'$ is therefore parallel to $G\ L$. Through o' draw the minor axis perpendicular to $c'\ d'$. To determine its length: from b' as a center, with a radius equal to $o'\ c'$—the semi-major axis—draw an arc, intersecting the minor axis at $o_{,,}$. Draw $b'\ o_{,,}$ intersecting the major axis at $o_{,}$; $b'\ o_{,}$ is the length of the semi-minor axis which should be laid off from o' to e' and f'. On the axes $c'\ d'$ and $e'\ f'$ construct the ellipse $c'\ e'\ d'\ f'$, which is the required elevation. As a test of the accuracy of the work, tangents to the ellipse $a\ d\ b\ c$ drawn perpendicular to $G\ L$ should also be tangent to the ellipse $c'\ e'\ d'\ f'$.

Fig. 10 illustrates the application of this construction in drawing the elevation A' of a cylinder whose plan A is given.

If the elevation of a circle be given, and it is required to draw the plan, the work is similar to that described above. The construction will be explained by inverting the drawing, Fig. 6, calling the ellipse $a\ d\ b\ c$ the elevation, and $c'\ e'\ d'\ f'$ the plan. I conclude this paper with a solution of a problem the construction of which is involved in Fig. 6.

Having given one axis of an ellipse and a point on the curve, it is required to construct the other axis.

Let $a\ b$, Fig. 7, be the major axis of an ellipse, and let p be a point on the curve; it is required to find the minor axis. Bisect $a\ b$ at o. Through o draw $c\ d$ perpendicular to $a\ b$. From p as a center, with a radius equal to the semi-major axis ($= o\ a$), draw an arc intersecting $c\ d$ at $o_{,,}$. Draw $p\ o_{,,}$ intersecting $a\ b$ at $o_{,}$. Lay off $o\ c$ and $o\ d$ each equal $p\ o_{,}$; $c\ d$ is the minor axis. We will now suppose that the minor axis $c\ d$ and the point p are given, and that it is required to find the major axis. Bisect $c\ d$ at o, and through o draw $a\ b$ perpendicular to $c\ d$. From p as a center, with a radius equal to the semi-minor axis ($= o\ c$), draw an arc intersecting $a\ b$ at $o_{,}$. Draw $p\ o_{,}$ and produce it until it intersects the minor axis at $o_{,,}$. Lay off $o\ a$ and $o\ b$ each equal to $p\ o_{,,}$; $a\ b$ is the major axis.

* The length of the minor axis is equal to the diameter of the circle multiplied by the cosine of the angle which the plane of the circle forms with the plane of projection.

The draftsman will see that these constructions conform to the principle of one of the well-known instruments for drawing ellipses, and that the curve may be plotted by points. Thus let $a\ b$ and $c\ d$, Fig. 8, be the major and minor axes of an ellipse. On a straight-edge, A, lay off $p\ o_{,} = c\ o$ and $p\ o_{,,} = b\ o$. Place the point $o_{,}$ on the line $a\ b$, and the point $o_{,,}$ on the line $c\ d$; p will be one point on the curve. If the point $o_{,}$ be compelled to move along $a\ b$ while $o_{,,}$ travels on $c\ d$, the point p will describe an ellipse by continuous motion. For let p, Fig. 9, be any point of the curve determined in this way. From p draw $p\ q$ perpendicular to $a\ b$ intersecting $o_{,,}\ q$, drawn parallel to $a\ b$ at q. In the similar right-angled triangles $p\ r\ o_{,}$ and $p\ q\ o_{,,}$ we have the following proportion:

$$p\ o_{,} : p\ o_{,,} :: p\ r : p\ q.$$

But $p\ q = \sqrt{\overline{p\ o_{,,}}^2 - \overline{q\ o_{,,}}^2}$

$$\therefore p\ o_{,} : p\ o_{,,} :: p\ r : \sqrt{\overline{p\ o_{,,}} - \overline{q\ o_{,,}}^2}.$$

Putting $B = p\ o_{,}$ the semi-minor axis.
" $A = p\ o_{,,}$ the semi-major axis.
" $y = p\ r$ the ordinate of p.
" $x = q\ o_{,,} = r\ o$ the abscissa of p.

The proportion becomes,

$$B : A :: y : \sqrt{A^2 - x^2}$$
$$\therefore A\ y = B\sqrt{A^2 - x^2}$$

Squaring both sides of the equation,

$$A^2\ y^2 = A^2\ B^2 - B^2\ x^2$$
$$\therefore A^2\ y^2 + B^2\ x^2 = A^2\ B^2,$$

which is the equation of the ellipse referred to its center. FREDERIC R. HONEY.

New Haven, Conn.

Errors in Indicator Reducing Gear.

Editor American Machinist:

I am pleased to find that my contribution on this subject has aroused some interest in this too often neglected matter. Mr. Booth's letter, which appeared in the AMERICAN MACHINIST for July 20th, calls, however, for more than mere acknowledgment. "Absolute accuracy in everything is very desirable," says Mr. Booth on the same page, so that his contention that my criticism is an "example of accuracy overstrained," is demolished on his own showing.

Coming now to sober facts, I would first say that, as already explained, I used somewhat exaggerated proportions in order to show the character of the error more clearly. Mr. Booth says I assume a long indicator card, which no one would use in indicating a *high-speed* engine. Now I have yet to learn that the gear is not equally applicable to slow-running engines, and so far as I can see, it is as likely to be used with the latter as with the former. I claim, therefore, that I am perfectly justified in selecting a length of card which may quite possibly be employed in practice, in order to show how serious the error may easily become under ordinary circumstances. The suggestion that the elasticity of the cord would counteract the distortion due to the gear, savors very much of the "two wrongs-making a-right" theory, and might just as easily be used as an argument against the use of "absolutely accurate" reducing gears.

Now with regard to the addition of the Brumbo pulley: Mr. Booth thinks I have not correctly understood the genius who recommends the use of the Brumbo on the vertical arm. Your correspondent says "the addition of the Brumbo is for the purpose of pulling the cord over a circular arc in place of along a chord, and not for the purpose of correcting the angularity of the connecting cord." If, however, Mr. Booth will kindly glance at column 1, page 4, of your issue for June 8th, he will find that the electrical scribe, referring to the error produced by the angularity of the cord due to the rise and fall of the top of the lever, says that this "may be *corrected by adding a curved rim to the lever* on which the cord may wrap." From this I think Mr. Booth will see that it is he after all who has not correctly read the criticism.

I made a special point in my article of pointing out how Professor Carpenter in describing the gear had laid particular stress on the error due to the rise and fall of the point of cord connection, while altogether neglecting the more serious error of which I demonstrated the existence. Now let us take the dimensions Mr. Booth suggests, and form a comparison of the two amounts of error. Mr. Booth finds the ends of the diagram to be $\frac{1}{320}$ or .0031 inch out of place. The versed sine of the arc described by the end of the vertical arm will be found to be .024 inch, and if we assume the direction of the cord when horizontal to bisect the versed sine, and take a length of connecting cord of 2 feet, the displacement due to this effect at each end will be $24 - \sqrt{576 - .000144} = .000003$ inch In other words, in the particular case selected, the error due to the use of the *triangular* cam, the existence of which the professor *ignores entirely*, is about *one thousand times as great as that due to the angular vibration of the cord*, to which he specially refers as being the *only* cause of inaccuracy in the gear.

In conclusion, I would like to inform Mr. Booth that he will find the gear in question (which has been used for some years now) fully described in Hawley's Treatise on the Arc Indicator, page 23, where it is specifically stated that "the motion is made perfect by grinding the inclined plane so as to get reduced equal movements of the driven arm for equal movements of the piston." The fact that, in practice, it has been found necessary to make this correction, proves very conclusively, to my mind, that the accuracy is not so overstrained in my paper as Mr. Booth would have us believe. M. E.

Conical Bearings.

Editor American Machinist:

In a recent number, one of your staff writes: "The workmanship upon the tools shown in this exhibit is of a high order. Hardened and ground steel spindles are used, with bronze boxes tapered outside and with provision for taking up wear."

I have heard the statement made so often, that conical and wedge-shaped wearing surfaces showed good work, that I beg leave to protest emphatically. On the contrary, I maintain that the conical bearing and wedge-shaped gib should never be designed where the simpler surfaces are admissible. Of course, it demands more skill mechanically, and, therefore, it costs more to make cone bearings and tapering gibs, and to that extent they represent good work; but they do not show good engineering necessarily, and to me they are often suggestive of sham. I receive the impression that the machine builder puts them on his machine to talk about them, rather than for their value.

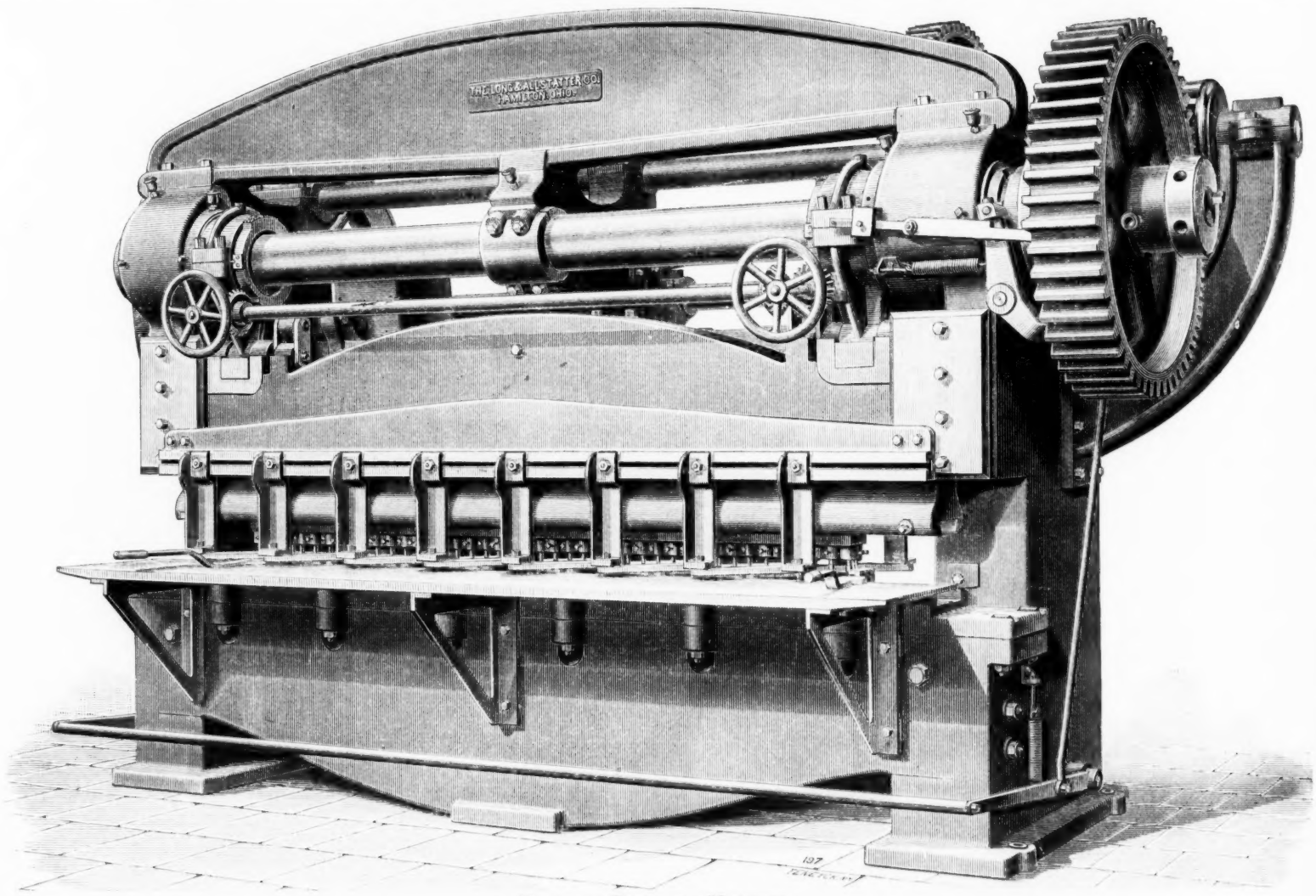
In a milling machine, when you wish to take up the lost motion, the spindle and box being in perfect order, it's very nice to be able to do so by moving the spindle or box endwise, but when wear has taken place, the spindle or box becomes irregular, and end motion of the spindle or box pinches the high spots, and does not take up the wear.

To take up the wear you must do just what is done with a straight cylindrical surface, restore the original surface in its truth, and rescrape it to its bearing. In what respect does a conical surface aid you, then? On the contrary, it costs much more to take up a cone bearing than a straight one. It costs more time and more skill. The same is true of the tapering gib. It will take up lost motion only when the wearing surfaces are true. As soon as they are worn, the gib will bind in spots.

Of course, the conical bearing and the taper gib are very nice subjects of conversation, and undoubtedly do aid the sale of machinery; but they are evidences of "good work," meaning "good engineering," in exceptional cases only. HENRY BINSSE.

Multiple Punching Machine.

The illustration shows one of the styles of multiple punching machines manufactured by the Long & Allstatter Company, of Hamilton, O. It is arranged for punching at one stroke rows or groups of holes in plates or strips. Plates as wide as the distance between housing can be passed through the machine from front to rear; long strips can be punched as far from the edge as the depth of the throats in the side housings.



MULTIPLE PUNCHING MACHINE.

As shown in the illustration the machine is fitted for punching at one stroke all the holes—sixty-six in number—in the steel tire of harvester wheels, about three feet in diameter, the distance between the centers of outside holes being nine feet six inches.

The depth of the housing throats is eight inches, measuring from the center of the slide to back of the throat. The machine has heavy steel cam shaft and is double-geared. An iron table is provided in front. The strippers are adjustable the entire length, and the tools are conveniently attached and changed. The slide is adjusted by a hand-wheel as the punches wear short, and an automatic stop is provided which brings the machine to rest at any point of the stroke desired. These multiple punching machines are made in different widths between housing, with throat depths and capacity to suit requirements. A machine similar to this is on exhibition at the World's Fair.

AMERICAN MACHINIST

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AMERICAN MACHINIST,
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☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds. As the majority of our friends who visit Chicago during the continuance of the Fair will spend a considerable portion of their time in Machinery Hall, we invite them to make use of our facilities there by having their mail addressed in our care as above, where it will be cared for and delivered on demand either by our own representative or by the person who cares for the space in which our desk is located.

Overrating.

It is in the weakness of human nature generally to overrate any mechanical contrivance that possesses something in the way of novelty, and the same is true when some performance beyond the ordinary is brought about by existing and well-known means. Of this last a recent example is in the speed that has been attained by railroad trains. Recent speed has undoubtedly been higher than previously reached. There has been, and is, a craze for high speed, but the —in many instances honest—overrating of speed has become so common that a basketful of affidavits would be ineffective in the way of convincing a man of the truth of statements that gave to a train a speed of more than the conventional sixty miles; that is, unless he is an interested party, then the case is different. This kind of overrating is rather harmless; it does not get a traveler to his destination any earlier—nor any later.

Perhaps one of the best examples of overrating and manufacturing theories to explain what was not so is in the instance of the steam engine indicator. In the use of the early forms of this instrument the peculiarities of the diagram were explained upon anything but the right ground, the opinion being that the steam in the engine cylinder behaved in the erratic manner believed to be indicated by the "hills and hollows" of the diagram. There was the instrument and it plainly said so, to those who wanted to believe in its perfection, notwithstanding a rather dull eye watching the action of the instrument could see what the trouble was without the least necessity for drawing upon the imagination, or spending time in thinking, or inventing any new theories. And when Richards turned his attention to the production of a better indicator, everybody interested in such matters came at once to remember what an important and rather interesting thing inertia was. It was concluded that the steam behaved rather rationally, after all. After Richards came others, until fairly perfect instruments were made, but there are a good many who have not yet recovered from the reaction incident to finding out—stopping to think—that all that was claimed for the indicator could not be true. If at first it had not been overrated, had been put forth for just what it was, put forth as a very good thing indeed and the best known for its purpose, there are those who would have a faith in it that they do not now possess. The general use of the indicator has been delayed more by its friends than by its enemies. It would have been much easier for them to have seen what modern skill had done for it if in its imperfect state it had not been so rather enormously overrated.

It is just as easy to reason from other examples. For instance, the best pumping engine duty fifty years ago was within twenty-five per cent. of the highest duty obtained up to date, and this notwithstanding modern practice in compounding, high steam pressure and, presumably, better boilers. Now in the face of this when a man proposes to save twenty per cent. of the fuel by a "patent" grate bar, he ought to and in the end will injure the prospects of introducing it. Or a saving of fifty per cent. by some new steam engine cut-off will, if it hits the first man, and does really possess merit, come to be considered considerably inferior to the old one.

Overrating may sometimes serve a temporary purpose, but if a man with something in the mechanical line to sell proposes to keep right along in the market, too much of it is bad. There comes the reaction when the pendulum of opinion will swing to the opposite extreme It bars progress, and tends to make men skeptical.

The Worst Form of Copying.

It sometimes seems as though we hear in this country rather more about manufacturers copying each other's designs and stealing each other's ideas than we ought to, and there are builders of machinery in this country who undoubtedly have reason to complain of what others are doing in this respect; but if our foreign consuls are to be depended upon there is a form of imitation of American manufactured goods carried on, in Germany largely, and to some extent in England, that is far worse than anything we experience here. It is charged in official reports that American stoves, sewing machines, revolvers, agricultural implements and hardware made in this country in the best manner and of the best materials are burlesqued in Germany by being reproduced in the vilest and cheapest manner possible, substituting castings of iron for drop-forged iron or steel, even to the extent of making a hatchet, for instance, entirely of cast-iron. Not only are the articles themselves imitated in this way, but the name of the American maker of the genuine article is imitated, along with all private marks, trade marks, etc., the idea being not only to steal the trade of the original manufacturers, but their good name as well; the South American or African purchaser of a cast-iron hatchet, a cast iron sewing machine, or a cast-iron revolver, having no means of knowing that it is not the American manufacturer whose stamp the article bears, that has swindled him.

It is charged that English manufacturers have been doing the same thing with American textile fabrics, especially those which the Chinese have taken a fancy to, and which they suppose they are buying of real American manufacture, when in fact they are buying a mosquito net and sizing imitation with the American manufacturer's name counterfeited and stenciled upon the goods.

It would seem to be to the best interest of all civilized nations to put a stop to this sort of business. We know of nothing so demoralizing and contemptible. When we consider that the reputation and good name of a manufacturer, that it may have taken him years to build up, can be ruined in a foreign country in such a despicable manner, no terms of condemnation seem too severe for the characterization of such a business; and when it is remembered further that even the firm engaging in such a traffic has no hope of building up for itself an honest or an enduring trade, that its operations can result only in driving out of the market not only the genuine goods, but the imitation as well, it would seem as though it ought to be an easy matter to secure concerted action among the civilized nations to stamp out such a nefarious trade.

Rigid Inspection Needed.

A recent disaster on Lake George by which nine persons lost their lives ought to call attention to the manner in which small steamboats are handled on inland lakes throughout the country in such a way as to bring about sharp action in the matter of reformation. A small pleasure boat run in the dark with an inexperienced man acting as pilot, crashes into an obstruction and immediately sinks with loss of life as stated. That is all there is to tell of the story, but there is a moral.

A few years ago steam navigation of the small inland lakes was rare. Now literally hundreds of these little bodies of water are traversed by small pleasure steamboats during the summer months, and any one is allowed to exercise his lack of skill as pilot or engineer. The boats are usually frail affairs, with little or no provisions for saving life in case of accident, and they are frequently heavily loaded with pleasure seekers, many of whom are women and children. Other conditions having been so radically changed during the past few years the conditions under which such boats may be used should be correspondingly changed. There has come to be about the same necessity for rigid inspection and license in the instance of these small pleasure boats that there is in the instance of more pretentious craft plying rivers and larger lakes. Being outside the jurisdiction of United States inspection service the several States should lose no time in providing for the necessary inspection. It is little else than a crime to neglect a duty made so plain by the unfortunate occurrence on Lake George.

Some years since, the late J. C. Hoadley, taking for his text an item that had been very industriously circulated, and in which an enormous loss of carbon in smoke was said to be wasted, showed the utter fallacy of such reasoning in an article written for the AMERICAN MACHINIST. Smoke is, in many instances, a very undesirable thing, but it has come to be understood that a little unconsumed carbon will go a long way in coloring things up, and in darkening the air about a large city. It is unfortunate that in the past nearly all smoke-preventing devices have been put forth on the plea of an important saving in fuel, based upon the supposition of a loss that did not exist. Of course the saving contemplated could not be effected; in fact, the means taken to prevent smoke have in nearly every instance resulted in loss in fuel economy, sometimes large, but not necessarily so. This has been a set back to "smoke consumers," which would not have been the case had they been placed upon their merits, viz., to avoid the nuisance of smoke at a small cost. This is not saying that there are any very satisfactory devices for preventing smoke, or that there are likely to be. These are rather open questions. But if an impossible attainment had not been looked for, a good deal more might have been done in the way of trying to the end of devising one than has so far been done.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(402) J. P. H., Meriden, Conn., writes: Please explain how the cores for small slide valve engine cylinders are made and placed in the sand. *A.*—See the article treating on cores for molding steam cylinders in dry sand in our issue of January 21, page 7, 1892.

(403) A. P. R., Harrison, Me., asks: Why will oil of vitriol freeze in a carboy full strength when it will not freeze in the same room when reduced for pickling castings, two parts of water to one of vitriol? *A.*—If this is so, the oil of vitriol at full strength freezes at a higher temperature than water.

(404) C. T., Torino, Italy, writes: Please inform me where I can find drawings of modern electric traveling cranes up to 40 tons. *A.*—We have not seen any book in which drawings of these cranes are published. We do not know where you could procure them unless the builders are willing to furnish them. 2. Will you publish drawings of the electric traveling cranes at the Chicago Exposition? *A.*—We have not yet decided whether to do so or not. 3. Which do you think is best, to use a single dynamo or three dynamos on each crane for

the three movements? *A.*—We prefer not to express an opinion on this subject.

(405) E. B. M., Muskegon, Mich., writes: Suppose I wanted to make a press fit of a certain diameter and for a given number of tons pressure; is there a rule or table to find the allowance? *A.*—There is no table of allowance for the above purpose that we know of; it would also be a difficult matter to establish a rule for finding this allowance, as much depends on the quality of the material. In shops where much of this kind of work is done the allowance has been found by experience, and suitable templates made for the purpose, and even with these considerable good judgment has to be used, as the quality of material may change the desired results.

(406) B. P., Howard, R. I., writes: Please give me a free-hand sketch of the core for a lathe bed 4 feet long and 5 inches wide, thickness of metal $\frac{5}{16}$ inch as shown in the accompanying illustration. *A.*—The shape of the core is represented by the dotted lines which show the inside of the bed in your illustration, to this must be added the projections which hold the core in place in the mold. You require no other sketch. 2. Please inform me how a core of this kind is made. Also please give me the name of a book that treats on cores. *A.*—You will find all the information you seek in "The Iron Founder," by S. Bolland, published by John Wiley & Sons, 53 East Tenth street, New York City.

(407) H. E. T., Greensburg, Pa., writes: Please give me your opinion in regard to the following matter: Do you think there are machines made for locating minerals in the earth? The reason for my asking this question is that I lately purchased a machine for which it was claimed that it would locate lead, but since I received it I have tried it, and found it will work only in the hands of certain persons, which leads me to believe that it works on the same principle as spirit rapping, that is, magnetism in the person's body, and not the attraction of the lead. I am positive there are minerals, especially lead, in the mountains around here, and therefore purchased the machine to locate it, but failed. *A.*—We have no faith in these machines, and believe that the only reliable one is the drill. In our opinion you have come to a correct conclusion relating to the working of the machine.

(408) J. E. T., Providence, R. I., asks: What kind of a lathe tool is best to use for turning soft rubber valve disks 6 inches diameter and $\frac{3}{4}$ inch thick? *A.*—To turn soft rubber is a very difficult matter, and if it must be done the tools should be forged and ground to a knife's edge, and made to cut the same as a knife; the shape is the same as that of tools for turning paper, such as we have illustrated in our issues of April 21, and May 19, 1892. 2. Is there not some simple rule for ascertaining the length of belt for any given set of pulleys? *A.*—For approximate results, but near enough for many practical purposes, the following rule may be used: Add the diameter of the two pulleys together, divide the sum by 2, and multiply the quotient by $3\frac{1}{4}$, then add this product to twice the distance between the centers of the shafts, the result will be the length of belt. The above is for open belts. For crossed belts the rule is not so simple. You will find this explained in our issue of July 21, 1888.

(409) H. T., Hagerstown, Md., writes: We are using a fire box steel boiler, 100 horsepower; it is 18 feet long, 66 inches diameter, contains 36 flues 5 inches diameter, and a dry pipe on top. The steam pipe is 4 inches diameter. The boiler supplies steam to a Corliss engine, 16x42 inch cylinder and makes 80 strokes per minute. The engine draws water from the boiler by spells when steam gets down, but does not hammer a bit; the water flows right through the engine and out of the 6-inch exhaust pipe into a cistern. It draws from 6 to 8 inches of water out of the boiler in the same number of minutes. How can we overcome the difficulty? We usually carry a steam pressure of 80 pounds. *A.*—From the fact that the engine draws water when the steam pressure gets down, which is liable to occur when feeding the boiler, we are inclined to believe that too much water is fed in at a time, thereby reducing the steam space and causing the engine to lift the water in the boiler. You will probably overcome the difficulty by carrying the water at a lower level. Of course care must be taken to keep the flues covered with water at all times.

(410) D. L. H., Dallas, Tex., writes: What is the best means of preventing scale in boilers? I know there are a number of chemical and mechanical cleaners on the market, and should be glad if you will send me the addresses of the manufacturers of some of the best of these. *A.*—The use of kerosene oil has given good results in many cases, and will probably prove satisfactory in your case also. In our issue of December 17, 1887, you will find complete instructions how to use it, and also the experience of an engineer who has used it to a considerable extent. However, much depends on the kind of water you are using. We have very little faith in boiler compounds, and should use none of them, unless we have the water analyzed, and then choose such as in our judgment will give satisfactory results. Of the few good compounds on the market we cannot recommend any particular one in preference to others. 2. If there is any good work at a reasonable price on this subject I should like to procure it. I presume you can get it for me. *A.*—Steam Boiler Incrustation, by C. T. Davis, price $2, published by H. C. Baird & Co., Philadelphia, Pa. We do not deal in any books.

(411) R. A., Brooklyn, N. Y., writes: Kindly inform me how to obtain a license for running a tug boat engine. *A.*—Apply at the office of the Supervising Inspector of Steam Vessels, Post-office Building, New York City. 2. What knowledge is required for obtaining a license? *A.*—You must have a thorough knowledge of running an engine, keeping it in order, and know how to act in case of an emergency. You must be thoroughly familiar with the management of boilers, and have a fair knowledge of the construction of engines and boilers, and be able to make simple computations which may present themselves in the engineer's department when repairs are necessary, or when questions in regard to the management arise; in short, you should have a good education, otherwise you will fail in your examination. No original license will be issued to any one who has not served at least three years in the engineer's department of a steam vessel, or as a regular machinist in a machine works. A person who has served for a period of three years as a locomotive or stationary engineer may be licensed to act as an engineer on steam vessels after having had not less than one year's experience in the engineer's department of a steam vessel. By the time you have complied with this rule you will know exactly what knowledge will be required for obtaining a license.

(412) G. M. M., Chatham, New Brunswick, writes: Please give rules for determining the sizes of the intermediate and low-pressure cylinders for a triple-expansion engine, when the size of the high-pressure cylinder, cut-off and steam pressure are known. *A.*—There are several rules, but none of them give exactly the same results. One simple rule is to make the diameter of the intermediate cylinder 1.5 times that of the high-pressure cylinder, and the diameter of the low-pressure cylinder equal to 2.5 times that of the high pressure cylinder. In this case the ratio of the low-pressure to high-pressure cylinder area is 6.25, and the ratio of the intermediate to high pressure is 2.25. Mr. J. M. Whitham in his book on "Steam Engine Design" gives the following ratios taken from actual practice.

Boiler pressure (Gauge).	Cylinder ratios.		
	Small.	Intermediate.	Large.
130	1	2.25	5.00
140	1	2.40	5.85
150	1	2.55	6.90
160	1	2.70	7.25

In these engines the steam is to expand to a terminal pressure of about 10 pounds absolute, with a piston speed of from 750 to 1,000 feet per minute.

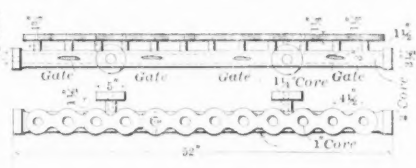
(413) M. L., Brooklyn, N. Y., asks: What is fluoride? *A.*—It is a compound of fluorine with another element. Fluorine is a gaseous element, not known in a free state, since its isolation is a matter of great difficulty and some doubt. It forms with other elements a group of compounds called fluorides. 2. Do you think it can be advantageously used for the prevention of scale in boilers, or corrosion? *A.*—We do not know; we have never tried it, nor seen it used. We are not in favor of using any chemicals in boilers, unless the water is analyzed by a competent chemist, and the proper compound selected. 3. I fitted two $\frac{1}{2}$-inch cocks under my two boilers, and a $\frac{3}{4}$ one on the hot well. I connected these cocks by tubes. The feed-water temperature previous to the addition of these cocks was 130 degrees Fahr., while now it is 168 degrees. I also believe that I have increased the circulation in the boiler by taking the water from the bottom and pumping it into the boiler near the top row of tubes. The feed pump works as well now as it did before. Do you think I have gained anything? *A.*—You have gained the advantages attendant upon the use of feed water of a higher temperature, and undoubtedly your arrangement will tend to increase the circulation in the boiler. We think favorably of the arrangement, and although the economy of fuel may not be appreciable, yet the tendency will be in that direction. Your other question, not repeated here, is out of our line.

(414) N., Toronto, Canada, writes: What is a short, simple and reasonably accurate method of calculating the proper size of piston and stroke for a double acting independent air pump and jet condenser; the horse power of engine being given? *A.*—Multiply the area in square feet of the engine piston by the stroke in feet and by the number of strokes per minute; divide this product by 16 and by the number of strokes of the pump, the result will be the capacity of the water cylinder of the pump in cubic feet. This rule may be stated in symbols as follows:

$$\frac{A \times S \times N}{16 \times n} = C,$$

in which A denotes the area in square feet of the main piston; S the stroke in feet; N the number of strokes of the main piston per minute; n the number of strokes of pump piston per minute; and C the capacity of the water cylinder of the pump in cubic feet. The above is suitable for simple engines; for compound engines, A represents the area in square feet of the low-pressure cylinder. There is no fixed rule for the ratio of stroke of pump to the diameter of the water cylinder; good results are frequently obtained by making the stroke equal to the diameter of cylinder. To find the stroke for this ratio, divide the capacity as found above by .7854, and find the cube root of the quotient, the result will be the stroke in feet and also the diameter of the pump in feet. 2. Are there any tables published giving this information? *A.*—Not that we know of.

(415) G. K., Louisville, Ky., writes: Inclosed please find a rough sketch of a 12-hole cast iron manifold with which we have had considerable trouble. It always leaks under a pressure of 200 to 250 pounds, the leak occurring at the neck opposite the gates. We are using the best of iron and have cast it in different ways but always with the same result. We have also separated every fourth flange, thinking the shrinkage caused the trouble, but this did



not help us any. *A.*—We are inclined to believe that the cause of the trouble lies in the casting of the pipe, or in cooling it; we notice that the flanges on the nozzles are very thick in comparison with the thickness of the pipe, and therefore great care must be taken in cooling it so as to avoid any internal stress in the casting. Your sketch shows a square junction between the nozzles and the pipe, which we believe to be a bad feature. We should give an easy curve to these junctions, and, if possible, separate all the flanges; or at any rate, separate the flanges half way between the gates, and not at every fourth flange. We presume that the gates indicated are gates for pouring the metal; since the leak appears to occur in the necks opposite these gates, we should place the latter between the necks. However, some of our readers may have had similar experiences and know a remedy for the leakage; if so we should be pleased to hear from them.

(416) W. G. R., Fitchburg, Mass., asks: What would be your advice to a young man who wants to take up marine engineering for a business after he has served his three years in a machine shop? Are there any books which you would advise him to read during his three years as apprentice boy, and where can they be obtained? *A.*—He should by all means devote his evenings and leisure hours to study during his apprenticeship. In our issue of February 19, 1891, we have indicated a course of study for apprentices, and a list of books to be used. If he studies these books and understands thoroughly the subjects treated on, he will, with his practical knowledge gained in the shop, be well equipped to enter the profession of a marine engineer. These books can be obtained by any dealer in scientific works. The addresses of some of these are given in our advertising columns, or they may be obtained from the publishers whose names are given in answer to Question 380 in our issue of August 20, 1891. After he has served his apprenticeship we should advise him to take a course in a technical institution where marine engineering is taught, but if he cannot afford to do so he need not be discouraged, but pursue his studies at home; the knowledge he has previously gained will assist him to lay out his own course of procedure. 2. Is it a business that requires a good understanding of mathematics? *A.*—It is absolutely necessary in this competitive age to have at least a thorough knowledge of the elementary branches of mathematics, and the more he knows of the higher branches the better. 3. Does one need to understand stationary engineering before he attempts this? *A.*—No. 4. Is there any better place to learn the construction and handling of marine engines than the shop in which they are built? *A.*—The shop is the best place to learn the construction of marine engines, and sea service is best for learning to handle them. 5. To whose shop would you advise a young man to go who wants to make good progress in this one branch alone? *A.*—We should advise him to go to the marine shop which is nearest to his home. Any one who is determined to learn and has the ability to do so can learn as well in one shop as in another.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

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"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO. 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

The Chicago Meeting of the American Society of Mechanical Engineers.

(Continued from last week.)

WEDNESDAY, AUGUST 2.

The session opened promptly, with Vice-president Hunt in the chair. The first paper was by Prof. Gustave Herrmann, of Aix-la-Chapelle, Germany, on the Operation of Centrifugal Machines. The subject is treated mathematically. In the course of the paper the author stated that if a disk be mounted for revolution upon a shaft, with the center of gravity of the disk not coinciding with the center of the shaft, and if, in revolving, the shaft should yield to the transverse strain so imposed upon it, the tendency would be for the disk to revolve with its own center of gravity as the center of motion. In other words, that the disk would tend under such conditions to shift the center of motion towards or to the center of gravity. This point Mr. F. H.

Ball, of Elizabeth, N. J., took issue with, and showed to be wrong, referring to some discussion of the subject by himself and the late J. C. Hoadley which was published in the AMERICAN MACHINIST about ten years ago.

The paper on The Removal of Dust from Workshops, by R. Kohfahl, of Hamburg, Germany, was presented by the secretary. It presented the advantages over all others of a new patented dust collector, and there were those present who certified that it worked well in Germany. Four other German papers, all of which were presented by the secretary in the absence of the authors, brought out no discussion, and the time thus gained gave the opportunity for the reading by the author of Mr. W. F. Durfee's paper on the Development of the Interchangeable System of Manufacture, a paper which is, in the main, historical, tracing the development of tools and manufacturing processes.

In the evening a reception was given at the General Engineering Headquarters, 10 Van Buren street, which was well attended and a very enjoyable affair.

THURSDAY, AUGUST 3.

The session opened promptly on time, with President Coxe presiding he, however, calling ex President Sweet to the chair before the end of the programme. This was essentially a steam engineering session, every paper presented, except two, being directly upon the subject of the steam engine, and those two exceptions closely related to it.

The first of these was by Prof. V. Dwelshauvers-Déry, of Liege, Germany (Honorary Member), and is called a "Contribution to the Theory of the Steam Engine." It deals entirely with theory and by mathematical processes. The paper was presented by the secretary, and called out no discussion.

The next paper, by Chas. T. Porter (Honorary Member), was on the subject of "The Limitation of Engine Speed," and the fact that this pioneer in the work of introducing high-speed engines is found in this paper declaring that high steam economy is impossible with them, and that piston speed should be rigidly kept as low as 600 feet per minute for all engines except those having a length of stroke of at least four feet, aroused considerable interest and discussion. Mr. Porter took the ground that there are no longer any practical limitations to rotative speed of moderate sized engines until a speed is reached where the excessive volume of clearance proportioned to the volume of steam admitted before cut-off seriously reduced the economy. Mr. A. K. Mansfield in discussion sustained the position taken by the author, and said that the Buckeye Engine Co. were now building three types of engines—high, medium, and slow-speed, and having clearance spaces of 2, 3 and 5 per cent. He believed there was a reaction toward more moderate rotative speeds, and he believed the move was in the right direction. Another member, however, thought differently, and that if a valve mechanism should be devised that would close the valve of a high-speed engine proportionately as quickly as is done with the Corliss release and dash pot, the economy would be as good.

The next paper was by Mr. Frank H. Ball, of New York, and was entitled, "Compression as a Factor in Steam Engine Economy." Briefly stated, the theory advanced by Mr. Ball in this paper is that governing of a steam engine to be most economical should be partly by the cut-off and partly by the compression, for where the cut off was altered, the compression should be also altered, in such a way as to give the card the greatest possible effective area. His position was vigorously attacked by a number of the members, some of whom, however, had evidently not taken the pains or had the opportunity to familiarize themselves with the paper sufficiently to discuss it to advantage. Mr. Ball stated, in conclusion, that some tests were yet to be made by Professors Denton and Jacobus at Stevens Institute that would probably show conclusively whether or not the theory advanced in the paper was right.

The next paper was by Professor Denton on the "Performance of a Triple Expansion Engine With and Without Jackets." The paper is a long one, and goes fully into details regarding the test of the engine which was used for pumping oil at Laketon, Indiana. It was discussed by about all the prominent engine men at the meeting, and at the conclusion of the discussion the merits or demerits of the steam jacket were still in a very unsettled state, though the published records of such exhaustive and well-conducted tests were, it was thought, well calculated to bring about definite knowledge of the matter in the end. In the course of the paper, it was stated that the best economy yet recorded as attained by a triple expansion engine was by a "Sulzer" engine, a Corliss poppet valve engine, built at Augsburg, Germany, which had showed a water consumption of 12.73 pounds of water per horse-power per hour. Mr. Barrus cited cases of two Allis engines, and one by the Corliss Engine Company, that had given better economy on tests, the Allis engines being used for pumping, and the Corliss for driving a mill.

The next paper, that of Messrs. William A. Pike and T. W. Hugo, was also a record of a test of a steam plant, in this case used for driving dynamos for a street railway system. As usual in such cases many points of the record were strongly attacked and as ably defended, the point especially criticised being that a very low rate of economy had been secured, which was explained by the fact that the engines worked under widely and very quickly varying loads so that they had to be much too large for economical running under usual conditions.

The next paper was on the subject of "An Evaporative Surface Condenser," by Prof. James H. Fitts, Professor of Mechanical Engineering in the Virginia Agricultural and Mechanical College at Blacksburgh, Va. As the paper was announced Secretary Hutton made the sad announcement that its author, Professor Fitts, had been killed in a railroad accident while on his way to attend the meeting. The paper gives a concise description of a condenser constructed by the author which had given good results. It called out no discussion except an expression of regret that Professor Fitts had not been spared to carry out the work begun with it, as in the paper he had expressed the hope of being able to do.

The next paper, that of Mr. George H. Barrus on "A Coal Calorimeter," which he described, brought out the fact that coal supposed to be the same in quality, taken from the same mine, might vary in actual calorific value as much as 10 per cent. after all corrections had been made for ash, etc. Mr. Kent thought this ought to show the importance of making tests of coal and of paying for actual value received instead of so much per ton regardless of quality. Professor Sweet mentioned a case in which a large consumer of coal had contracted for it upon a basis of the amount of water evaporated instead of by the ton.

The last paper was by T. W. M. Draper on "Anhydrous Ammonia Gas as a Motive Power," and described a new motor for using this gas.

At 2 P. M. the deferred trip to the Fair grounds by the whaleback steamer, the "Christopher Columbus," was taken, the boat steaming from the pier at the foot of Van Buren street near the hall. The trip was a very pleasant one and upon arrival at the grounds many of the engineers went on a little excursion out into the lake two miles to one of the water-works tunnels, some of the party descending into the tunnel.

FRIDAY, AUGUST 4.

Several very interesting and valuable papers were presented at this meeting, notably that of Mr. Fred. H. Daniels, of Worcester, on "Wire Rod Mills and Their Development in America"; that of Mr. Thos. H. Brigg, of Bradford, Eng., on "Haulage by Horses," and that of Prof. Robert H. Thurston on "Technical Education in the United States." Some of these may be treated in our columns in future; but Professor Thurston's paper, which is largely historical, statistical and economic, takes up 150 pages, and is therefore much too long for any adequate presentation. The discussion upon it, however, showed that much interest is taken in the matter of technical education. In presenting the paper Professor Thurston gave a very interesting abstract from it, in which he called attention to the fact, as recorded in Draper's "Intellectual Development of Europe," that there was in Alexandria, 2,000 years ago, a technical school. In the middle ages the idea of technical education died out entirely to be again revived within the last 200 years. At present its growth and the increase of interest in it were very rapid.

In discussing the paper, Mr. Kent said, among other things, that it had been shown in some cases that boys who had had the advantage of manual training had shown themselves the best and most capable students in subsequent courses of study, even in cases where there was no opportunity to use directly the knowledge or practice thus gained; the advantage seeming to come from the fact that the general intellectual powers of a youth seemed to be best developed where manual training was part of the system of preparatory education. In the course of his remarks he stated that while it was true that America was ahead in some things, there were many others in which other nations were even with, or superior to us. Other nations had been leading us in engines, especially in compounding and in marine practice, and the exhibit of German machine tools at the Fair showed that Germany was our equal in the matter of machine tools—this last being a statement, by the way, which would be very far from being sustained by a thorough examination of the subject by one familiar with machine tools. Mr. H. F. J. Porter thought the matter of technical education bore a close relation to the matter of the professional standing of engineering, and that there should be some uniformity in the engineering courses of the different schools, so that when a man was graduated from any one of them the public might know what his diploma meant. This, of course, opened the whole question which has so often been discussed regarding the advantages of a technical education *per se*. One member who had himself gone into a machine shop in his younger days, where, when he saw the need of light on any subject, he simply worked for that light, now recognized the value of technical education, and had placed his boys where they were receiving it. He thought that such an education taught men to be precise and exact in all their dealings and relations in life, whether they followed an engineering profession or not. Mr. Durfee thought not enough attention was paid by the schools to selecting the proper materials, and excluding those young men who by nature could never hope to become competent engineers; Mr. Thurston replying to this by stating that only about one-half of the young men who started in to take the engineering courses in the best schools went through them; the rest being weeded out by examinations which they were unable to stand, or advised to give it up. Professor Alden, of Worcester, endorsed that part of a resolution offered by Mr. Porter, in which it was proposed that the schools should confer the title of Bachelor of Engineering only, leaving the full title of M. E. or C. E. to be conferred afterwards by some competent authority representing the profession, and then only after proof of fitness for the degree. He thought it would be impossible to secure uniformity in the methods of instruction, but it might be practicable to secure a uniform standard of scholarship and attainments. President Coxe said that in his own experience and observation of the success or failure of engineers he had been led to consider the foundation the all important thing. He thought that a man well grounded in the principles of science and of physics would be apt to succeed about equally well in any branch of engineering to which he might give his attention. Such a man would not be going after more power from a machine than was put into it, or other wild schemes, and would save his employers lots of money. The laws of nature were the same, and had to be dealt with, whether you pumped water from the bottom of a mine or from Lake Michigan, and the man thoroughly familiar with those laws would be most likely to succeed.

One curious phase of the discussion of this paper was that in which Professor Goodman, of Leeds, declared that the public money devoted to technical education was better spent here than in England, the idea seeming to be there to give a large number of youths an elementary knowledge of science and technical matters, while here we gave a better scientific and technical education to the few, and that our graduates were therefore more highly regarded by employers. An intended compliment which might be taken as a real one or not, depending upon what one's idea may be regarding the proper expenditure of public funds for educational purposes.

In the evening a reception was given to the visiting engineers and their friends in the Mines Building at the Fair grounds which was a very pleasant affair, all the exhibitors of mining products and of mining machinery taking pains to be present or to be represented by those who could give any desired explanation. Admission to the building was by card only, and music and a collation were features of the evening, the engineers being the guests of the Chief of the Department of Mines and the exhibitors. Again the Midway Plaisance was practically thrown open to the guests, and many of them spent the later portion of the evening in the cars of the great Ferris wheel or in viewing the other wonders of that famous thoroughfare.

SATURDAY, AUGUST 5.

In most of the divisions of the Engineering Congress the special sessions had closed on Friday, Saturday morning being devoted to an assemblage of all the divisions in what is called the Hall of Washington, which is larger, but has as uncomfortable chairs and is as much subject to the annoyance of the puffing, blowing and general disturbance of the locomotives as the smaller hall in which the A. S. M. E. had been meeting.

Gathered on the platform soon after 10 A. M. were to be seen most of the notable engineers mentioned at the beginning of this account besides others, who had gathered to review the work of the congress and to exchange courtesies. Mr. Chanute presided and introduced, one after the other, the presidents of the various divisions, who gave an account of what had been done during the week. Mr. William Metcalf, speaking for the civil engineers, said:

"Sixty-three papers in all were presented. Of these papers which treated on a great variety of subjects, Germany furnished 20, Mexico 6, Portugal 5, England 3, Holland, France, South America and Canada 2 each, Italy, Nova Scotia and Australia 1 each, and the United States 18. The interest shown in the papers is evidenced by the fact that 318 engineers registered, while the average attendance at each session was about 125. The discussions took a wide range. It is impossible to speak in detail of the large number of valuable contributions to our literature that were made, but it may be asserted generally that the results of our congress will be far-reaching and productive of great benefit to the profession of engineering all the world over."

President Eckley B. Coxe, speaking for the mechanical engineers, alluded to the great interest that had been taken in the proceedings, the unusually large attendance, considering the attractions outside. The papers presented and the discussion upon them had impressed him with the fact that engineering tended more and more to exact statements of definitely ascertained facts, by men competent to ascertain and properly interpret them. Continuing he said:

"Engineering papers in these days are not simply suggestions of men with bright ideas and no experience. They are the results of experience given, in exact terms, showing the pounds of water evaporated per pound of coal, or the horse-power developed by a pound of steam, as the case may be. It seems to me that the construction of machines by actual guess has about passed away, and that no designer or constructor of machinery who hopes to place his machine in competition in any market can any longer neglect a thorough professional consideration of every question and every detail that comes into play in the use of such machinery. One of the most important reports we received in our congress was that of our committee on standard tests, and I believe that this congress will ever remain a notable gathering in the history of the profession, for the reason that we are inaugurating a system of international testing, so that work done in one country will not be repeated in another. This is an important subject and the engineering world should give it close attention."

Commodore Melville was the last to report for the division of Naval and Marine Engineering. He said that there had been an average attendance of about seventy in that division, and that the papers read and discussed would, he thought, prove to be very valuable to the profession and to shipping interests generally. He was glad to know that his own opinion regarding this had been sustained by one of the most eminent engineers in that line, who had declared that the published proceedings would constitute the most valuable and useful volume ever published on the subjects of which it will treat. He felt it to be his duty to publicly acknowledge the help rendered the division by the publishing firm of John Wiley's Sons, of New York, who had taken up the matter entirely free of cost to the new organization, depending for their reimbursement upon the sales of the volumes.

Following Commodore Melville's address were those of the foreign delegates, many of whom addressed the meeting to express their great appreciation of what had been done for their entertainment and instruction, and their very high opinion of American achievements in mechanics and engineering. Among the speakers were Professor Unwin, of England, and Professor Reuleaux, of Paris, names known the world over in engineering circles, and both of whom spoke in the highest terms of appreciation of what they had seen here. Professor Reuleaux especially seemed astonished at what he had found here, and declared that in many things we were pre-eminent, especially in the matter of precise measurements and the means for making them. American engineers would, he declared, be henceforth recognized as the masters of the world. Several of the representatives expressed themselves as much interested in the study of what they called the "American system of manufacture," by which large numbers of pieces, the duplicates of each other, were produced by special machinery and gauges. Responses were made for Germany, Sweden, Italy, Austria-Hungary, Russia, Switzerland and Belgium, all the representatives trying to outdo each other in praise of what they had seen and heard while here, after which the congress was declared adjourned.

Construction of the Ellipse.

BY CARL G. BARTH.

Having noticed the two articles on "The Ellipse" in your valuable paper of June 15th and 22d, I think the following method of approximating an ellipse of moderate eccentricity by means of two circular arcs may be of interest to the author of those articles and perhaps others.

In Fig. 1 $a\ b$ is the major and $c\ d$ the minor axis of the ellipse to be approximated.

Lay off $b\ e$ equal to the semi-minor axis $c\ o$, and use $a\ e$ as radius for the arc at each extremity of the minor axis.

Bisect $e\ o$ at f and lay off $e\ g$ equal to $e\ f$ and use $g\ b$ as radius for the arc at each extremity of the major axis.

This method was discovered by me over fifteen years ago while I was still a student in a technical school in my native country, and was introduced by me into the Franklin Institute drawing school over ten years ago. The following mathematical investigation is, however, of a more recent date.

Denoting the semi-major axis $a\ o$ by a and the semi-minor axis $c\ o$ by b, the radius of curvature at each extremity of the minor axis of the true ellipse equals $R = \frac{a^2}{b}$, and hence the radius R_1 of the arc to approximate the ellipse at these points must equal an expression smaller than $\frac{a^2}{b}$, but having, same as R, a for a limiting value as b approaches a, when the ellipse approaches a circle.

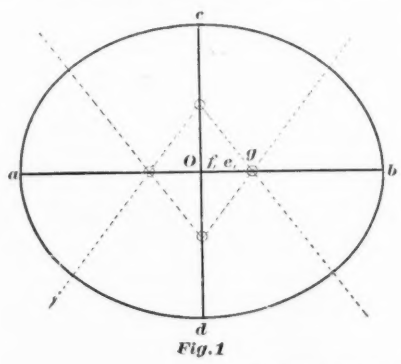


Fig. 1

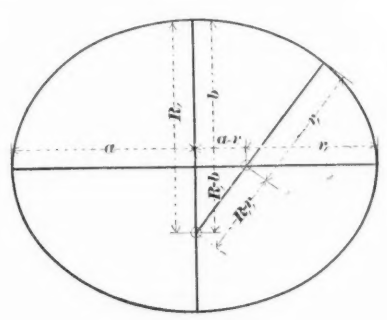


Fig. 2

CONSTRUCTION OF THE ELLIPSE.

It will readily be seen that R, as determined by the method just described, is equal to $2\ a - b$. This expression becomes a for $b = a$, and to prove that it is always less than $\frac{a^2}{b}$ when b is not equal to a, put by hypothesis,

$$2\ a - b < \frac{a^2}{b}$$

$$2\ a\ b - b^2 < a^2.$$

$$a^2 - 2\ a\ b + b^2 > o.$$

$(a - b)^2 > o$ which is true as b is always less than a.

Referring to Fig. 2 it is evident that the radius r_1 of the arcs at the extremities of the major axis must be such that

$$(R_1 - r_1)^2 = (R_1 - b)^2 + (a - r_1)^2,$$

which gives

$$r_1 = \frac{2\ b\ R_1 - a^2 - b^2}{2\ (R_1 - a)} = \frac{3\ b - a}{2}$$ for the above value $2\ a - b$ of R_1, and which will readily be found to be the value of the radius $g\ b$, Fig. 1.

It is, however, further necessary, not only that the expression $\frac{3\ b - a}{2}$ for r_1 shall always be greater than the expression $\frac{b^2}{a}$ for the radius of curvature r at the extremities of the major axis of the true ellipse, for all values of b less than a, for which the method can be considered applicable, but the ratio $\frac{r_1}{r} = \frac{3\ a\ b - a^2}{2\ b^2}$ must even increase as we diminish the ratio $\frac{b}{a}$, and hence the maximum value of $\frac{3\ a\ b - a^2}{2\ b^2}$ will determine the smallest value of $\frac{b}{a}$ for which the method can be at all considered applicable.

To determine this, put $\frac{b}{a} = n$, which gives $b = n\ a$ and makes

$\frac{r_1}{r} = \frac{3\ a\ b - a^2}{2\ b^2} = \frac{3\ n - 1}{2\ n^2}$, which is a maximum for $n = \frac{2}{3}$.

Hence the method cannot be considered at all applicable for cases in which the minor axis is less than $\frac{2}{3}$ of the major, but up to this limit the results are as good as for any similar method that has ever come to my notice, and should therefore commend itself on account of its far greater simplicity.

MANUFACTURES.

A paper-mill is to be erected at Carlinville, Ill.

W. T. Watt will start a tannery at Waco, Tex.

An increase will be made in Reading, Pa., waterworks supply.

G. W. Featherstone is erecting a cotton ginnery at Cedartown, Ga.

The DeWitt Milling Co., of DeWitt, has formed with capital $10,000.

The Ellingwood Mfg Co., Harrison, Me., is building a 50-foot addition.

W. H. & J. L. Pitts will erect a cotton gin, press, etc., at Pulaski, Tenn.

The River Spinning Co.'s mill at Woonsocket, R. I., is being enlarged.

Smith & Wade, manufacturers of shoe trimmings at Brockton, Mass., have enlarged their quarters.

The King Spring and Gear Company, of Buffalo, N. Y., talks of establishing its plant at Attica, same State.

Operations in the locomotive department of the West Milwaukee, Wis., car shops have been resumed.

It is reported that the Arlington Mills Manufacturing Co. will build a $12,000 factory at Wilmington, Del.

The New Castle (Pa.) sheet-mill has been completed, and is about to be started up with about 300 hands.

John J. McDonald and C. W. Gibson have formed the Aberdeen (Miss.) Cotton Co. The capital stock is $10,000.

The Walker Foundry Co., of Erie, Pa., capital stock, $25,000, has been formed by B. A. Walker and others.

The Acme Automatic Machine Co. has been incorporated in Alexandria, Va., with a capital stock of $50,000.

A beet sugar factory, with a capacity of 400 to 600 tons of beets per day, is to be erected in Los Angeles, Cal.

B. F. Avery & Sons, manufacturers of plows, will erect a brick factory building, to cost $6,000, at Louisville, Ky.

Hilles & Jones, Wilmington, Del. issue a neat folio in which will be found a list of the tools they exhibit at Chicago.

Hill, Clarke & Co., Boston, Mass., have issued a catalogue of machine tools on exhibit at the Columbian Exposition.

The New Orleans (La.) Shoe and Leather Manufacturing Co., Limited, has been incorporated with capital stock $50,000.

Hayden & Dunbar have commenced the rebuilding of their recently burned foundry and machine shop at Carleton, N. B.

The Gunnison Mining Co., Chicago, has formed with capital $100,000. Incorporators, Byron M. Fellows, J. and Fred S. Comstock.

A large shoe factory will be erected at North Abington, Mass., by George Hall, of Rockland, for several years of the firm of French, Hall & Co.

The New England Steel Works, at Worcester, Mass., is to make an addition, 50x50 feet, to its steel casting foundry, which will increase its output.

The Delaware & Hudson Canal Company has purchased a site for a new station at Scranton, Pa., and plans for the new building are now being completed.

At Newport, Md., the Nut and Bolt Iron and Steel Works and the Dayton Nut and Bolt Works, valued at over $70,000, have been purchased by John Trapp, who will form a stock company.

The Economic Manufacturing Co., Lincoln, Ill., has been incorporated, with a capital of $100,000, to manufacture apparatus for burning hydro-carbon oils. Incorporators: John P. Keller and August Becker.

The Ingalls Manufacturing Co. has been organized, at Portland, Me., for the purpose of making machinery, tools and mechanical articles, with $50,000 capital; officers: President, K. I. McKanzie; treasurer, S. P. Smith.

The Pittsburgh Locomotive Works, Pittsburgh, Pa., has issued a very interesting book, in which are illustrated the company's exhibits at Chicago. Full specifications are given which will make the book valuable to students and others interested in locomotives.

Thomas Devlin & Co., of Philadelphia, have just completed a handsome addition to their establishment. The new building is six stories high, 140 feet long by 40 feet wide, and will considerably increase their facilities for turning out goods.

An addition, 54x25 feet, is being built to the engine house of Bennett Mill No. 1, of New Bedford, Mass., to make room for an additional engine for that mill. The boiler house is also being enlarged by an additional building, 40x20 feet, to make room for two more boilers.

The Herendeen Manufacturing Co., Geneva, N. Y., has issued a new catalogue of hot water and steam boilers for heating purposes. A good deal of space is given to illustrations of buildings—largely private residences—heated by the "Furman" boiler, which the company manufactures.

The Poland Paper Co., Mechanic Falls, Me., is at work on a big mill that will work a revolution in its business. It is designed to erect a mammoth mill that will take in all the machinery of the four present mills on the Poland side of the river. The building will require two millions of bricks to complete the work.

The National Machinery Co., Tiffin, Ohio, has issued two catalogues—one illustrating their general line of machinery for making bolts and nuts, spikes, wire nails, machines for upsetting, bending, punching, etc., and special machinery, and the other describing the National rock and ore crusher with other machinery for mining purposes.

The Franklin iron foundry, Franklin, Mass., is to remove its business to Milford. Contracts for its building have been made. The main building will be 102x47 feet, one story with monitor roof; office and pattern shop, 60x25 feet, two stories; shipping and packing shop, 20-20 feet, two stories; core shop, 20x20 feet, one story; shed, 30x20 feet, one story.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for the new power station for the Atlantic Improvement Co., Astoria, L. I. There will be two buildings, a boiler house 62 feet wide and 85 feet long, with a dynamo room 70 feet wide and 130 feet long. The dynamo room is controlled by a traveling crane, to be furnished by the same parties.

The New Philadelphia Iron and Steel Company, New Philadelphia, O., will soon commence the erection of a new steel building to be used as an annealing house. This structure will be connected with the sheet mills and an electric crane will run the entire length of both buildings. These sheet mills have commenced operations after the usual summer shut-down.

Quite an important affair is the recently formed California Oak Leather Association, incorporated at San Francisco with capital $3,000,000. A few of the incorporators are: Herman Kullman, of Kullman, Salz & Co., San Francisco and Benicia, and Kullman, Wagner & Co., Stockton, dealers in hides and leather; A. B. Patrick, of A. B. Patrick & Co., incorporated, tanners, San Francisco; Oscar J. Kron, of Kron Tanning Co., San Francisco; Frank W. Sumner, of W. B. Sumner & Co., hides, San Francisco.

The Berlin Iron Bridge Co., East Berlin, Conn., say in a little folio: Our new catalogue of over 300 pages, illustrating and describing iron buildings for machine shops, foundries, rolling-mills, castings shops, electric light and power plants—in fact all classes and kinds of manufacturing buildings—is now ready for distribution. The expense of this catalogue is so great that we cannot afford to send it broadcast, but if you are interested in this class of work we would take pleasure in mailing you a copy if you so desire.

The Hoppes Manufacturing Company, of Springfield, Ohio, are building for the Clark Thread Company, of Newark, N. J., three exhaust steam feed-water heaters, two of 800 H. P. each and one of 1,500 H. P. These heaters are built on the same plan as the regular heaters manufactured by this company, except that they are constructed of different material, owing to the corrosive action of the feed-water used, which is taken from the Passaic River. The pans and the bottoms of the shells of these heaters are made of Tobin bronze, as it has been found that this material is impervious to the action of the acids present in the feed-water used.

A joint stock company, composed of Bristol men, with a capital stock of $6,000 has just been formed to carry on the wood turning business in the old Ingraham Case shop. The stockholders are: W. P. Stedman, O. F. Strunz, W. E. Sessions, Fred Davey, Ellis Hughes, G. S. Hull, George Hall, R. Baldwin, C. L. Wooding, F. H. Williams, R. A. Potter, Lester Goodenough, R. B. Codling. The officers elected are, R. Baldwin, president; Robert A. Potter, treasurer; C. L. Wooding, secretary. The patents held by this company are on the inventions of R. B. Codling for the automatic adjustment and delivery of the pieces of metal or wood which are turned by the application of an old principle, by which a series of cutting tools pass by the surface, finishing the work with a high polish, leaving it complete as it falls from the machine. The invention represents six years' study and effort by Mr. Codling in perfecting the machine, and all practical wood turners pronounce it a triumph. It works wood or metal, turning automatically any outline, and so nicely does it work that knots and cross-grain wood turn as well as straight grains. Mr. Codling will have charge of the business and bright prospects are ahead for the new concern.—*The Bristol* (Conn.) *Herald*.

Machinists' Supplies and Iron.

New York, August 12, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12 50 to $13 50 for No. 2 and $11.75 to $12.50 for Gray Forge.

Antimony—The market is dull. We quote L. X., 10.15c. to 10¼c.; Cookson's, 10.25c. to 10½c.; Hallett's, 9.80c. to 9.85c., and U. S. French Star, 10½c.

Copper—The market is dull and nominal at 9.75c. to 9.80c. asked and 9.50c. bid for Lake Copper. Casting Copper is held at 9 50c. to 9.75c.

Lead—The market is dull, 3.50c. to 3.35c. is asked, but this does not attract buyers.

Lard Oil—Prime City is quoted at 65c to 67c.

Spelter—The market is quiet at 3 90c. to 3.95c. asked and 3 65c. bid, without business.

Tin—The market is dull and nominal at 18.40c. asked for spot delivery, 18.45c. for August and 18.60c. for September. No business is reported.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Draftsmen to sell new comb. triangle, pat. protractor, etc. D. J. Kelsey, New Haven, Ct.

Wanted—Position about Sept. 15, by draftsman, with exp. designing gen. mach'y. Box 72, Am. Mach.

Wanted—Situation by competent mechanical draftsman. C. D., 1089 Broad St., Newark, N. J.

A1 pattern maker has $3,500 and services to invest in paying business. "Push," Am. Machinist.

Good lathe hand, with 11 years' experience in shops, wants position. H. J., Am. Machinist.

Experienced designer and engineer of 10 years' American and 10 years' German practice is open for engagement. Box 63, American Machinist.

Pattern maker, 30, first-class, thoroughly experienced, good draftsman, steady habits, good refs., wants employment. A. Bunting, Streator, Ill.

Wanted—Situation by mechanical draftsman, experienced on general machinery and machine tools; good designer. Box 68, Am. Machinist.

Tool maker, steady; 12 years' experience modern machinery and tools, cutters, taps, dies, etc., wants position. Box 71, American Machinist.

First class pattern maker wants situation; for 10 years foreman of a leading shop; highest references Address Pattern Maker, Am. Machinist.

Wanted—Situation by first-class mechanic, as general foreman or assistant in general machine shop and first-class engine works; thoroughly understands indicator. J. D., Am. Machinist.

Wanted—A young pattern maker, as instructor in woodworking; compensation, expenses and the chance for a good mechanical education in New Mexico. State age, experience, and references, to Box 69, American Machinist.

An engineer who has directed the drafting force of one of the largest manufacturing establishments in the country, and who is familiar with the most economical methods of shop and drawing room practice, will be open for an engagement September 1. Address L. A. W., American Machinist.

First-class all around machinist and tool maker, desiring a more thorough technical education, seeks position as instructor or assistant in machine shop of some College or University; reliable references regards experience, ability, etc.; salary to cover expenses. Address Box 70, Am. Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O

Light and fine machinery to order: Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Thousands of tons of machinery molding sand for sale at Geo. D. Slade's, Waterford, N. Y.

Rubber, metal and composition patterns for carding & grouping; small rubber & metal work to order. John T Usher, 116 E. 54th St., New York.

Witte Bros., pattern makers; fine work a specialty; orders promptly executed. 23 Carlton Ave., (rear) Brooklyn, N. Y.

We will pay 50 cents each for copies of the American Machinist of December 4, 1886 issue, must be unsoiled and in good condition. American Machinist Publishing Company, 203 Broadway, New York.

For sale—A complete set of patterns for a 12x8 screw cutting automatic cross feed engine lathe, with all modern improvements; easy to build some new features, and a very good tool room lathe; this is a bargain; patterns cost $250; will be sold for $100 cash. W. H. Ermentrout, Reading, Pa.

FOR SALE,

Diagram of tension in fly-wheel rims; also ready-made drawings of engines, belt pumps, &c.
E. W. STEVENS, 2748 N. 15th St., Philadelphia, Pa.

THE CORRESPONDENCE SCHOOL OF MECHANICS,

SCRANTON, PA.

Ques. What is The Correspondence School of Mechanics?

Ans. It is an educational institution intended to meet the wants of Machinists, Mechanics, Locomotive, Stationary and Marine Engineers, Firemen, and others interested in Mechanical pursuits who cannot afford to quit work to attend the regular technical schools in order to obtain the education which they need. It teaches Mechanical Drawing and the theory of Mechanics by Correspondence.

Ques. What are the branches taught?

Ans. Arithmetic, Algebra, Geometry, Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Heat, Mechanical Drawing, Steam and the Steam Engine, Strength of Materials, Applied Mechanics, Boilers, Machine Design, Electricity, and everything included in a complete Mechanical Engineering education.

Ques. Are all these branches taught by mail?

Ans. Yes. There are now over 600 students studying in this School who are making good progress.

Ques. What qualifications are required to enroll as a student, and when can students commence?

Ans. The only qualification necessary is to know how to read and write: Students can begin at any time.

Ques. How is instruction given by mail?

Ans. In place of the text-books of the regular schools, the students receive carefully prepared and liberally illustrated Instruction Papers and Mechanical Drawing plates, covering all the subjects embraced in the Complete Course. These are accompanied by Question Papers containing questions upon the subjects treated of and problems based upon the principles explained. The student studies the first Instruction Paper and writes the answers to the questions and problems in the accompanying question paper, and sends his work back to the School. This work is carefully examined by competent Instructors and if errors have been made, the necessary help is given, and it is returned to be done over. The student is furnished with blanks with which to write for an explanation of anything in the Instruction Paper he may not understand. The student is kept studying each Instruction Paper until he has a thorough knowledge of the subject treated of when he receives a passing mark on the records of the School and is advanced to the next Instruction Paper.

Ques. Is it possible to teach Mechanical Drawing by mail?

Ans. Yes. The information given is full and clear, the exercises are practical and instructive and the drawings furnished to be copied are worked out in detail. Persons who will apply themselves can learn not only to draw but to design Machinery.

Ques. What advantage has this method of study over that of the regular schools?

Ans. An education is procured without leaving home or losing time from work. The student can take his own time to study. He has his teacher always at hand. He can advance according to his ability and time without reference to other students. Should sickness prevent him from studying he does not lose standing. The cost of the Scholarship is less than tuition in other schools. The best way to remember a thing is to write it down.

Ques. What are the Scholarships?

Ans. The branches taught are divided into two so called Scholarships: The Complete and the Mechanical Drawing Scholarships. Holders of the Complete Scholarship are entitled to instruction in all the branches taught in the School. The Mechanical Drawing Scholarship includes the first nine branches mentioned above.

Ques. What are the prices of Scholarships?

Ans. The Complete Scholarship costs $35.00 in advance or $40.00 in installments. The Mechanical Drawing Scholarship costs $25.00 in advance or $30.00 in installments.

Ques. How are the installments paid?

Ans. Ten dollars with the application for admission and the balance in monthly installments of $5.00 each.

Ques. If a student is unable to pay his installments promptly does he lose his Scholarship and the money he has paid?

Ans. No. If on account of sickness or any reasonable cause a student is unable to pay promptly the time of payment is extended.

Ques. What are the expenses connected with the course?

Ans. Only those of postage, stationery and that of instruments and material to do the Mechanical Drawing work. By an arrangement with The Technical Supply Co., of Scranton, Pa., we are able to furnish students with these at very reasonable prices.

Ques. Are students required to purchase text-books?

Ans. No. The Instruction Papers form a complete text-book and are all that are necessary.

Ques. Are Diplomas given to students completing the course?

Ans. The graduate receives a Diploma stating that he has completed the course of study embraced in his Scholarship and that he has successfully passed an examination in all the branches.

Ques. For whom is this School intended?

Ans. Machinists, Mechanics, Draftsmen, Engineers, Firemen, and all connected with the Mechanical industries who are anxious to advance. It is an opportunity for them to obtain the technical education necessary to secure better positions and better pay. It is the only way to get an education without leaving home or quitting work.

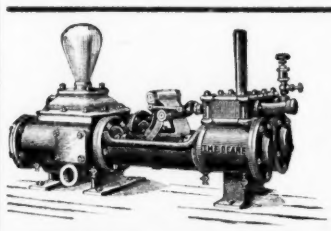
Ques. Does it require a long time to complete the course of study?

Ans. No. The Instruction Papers are carefully and concisely written by competent Mechanical Engineers. Everything unimportant is omitted and only that retained which is necessary to make clear to the student what he must know. The course is as short as is consistent with thoroughness.

The Complete Course requires for those who can only devote a few hours after work to study about 18 months; the Mechanical Drawing Course about 9 months.

Ques. How can I obtain more information about the School?

Ans. By writing to The Correspondence School of Mechanics, Scranton, Pa., they will gladly send you a free Circular of Information which contains all particulars of the Course of Study, Method of Instruction, Terms, etc.



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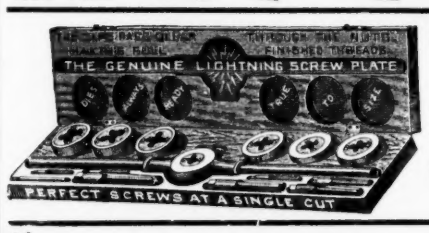

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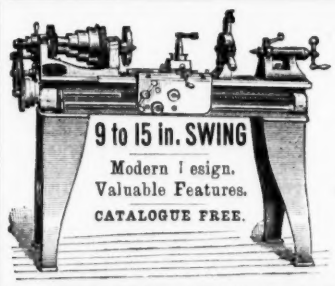

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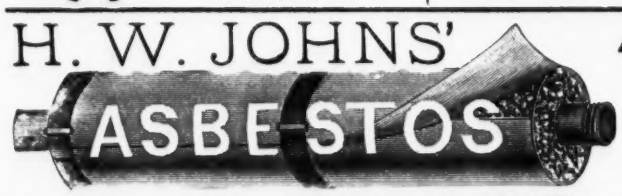

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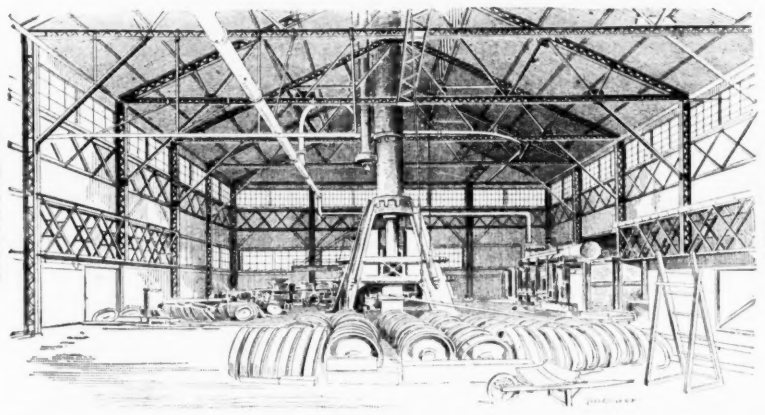

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The above illustration is taken direct from a photograph and shows the interior of a Forge Shop designed and built by us for The Boies Steel Wheel Co., at Scranton, Penn. The building is 80 feet in width and 108 feet in length, constructed entirely of Iron and Glass. Light for the interior is secured from the windows placed near the roof. There being no wood-work about the construction the building is absolutely fire-proof.

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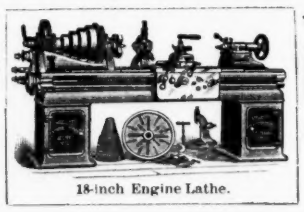

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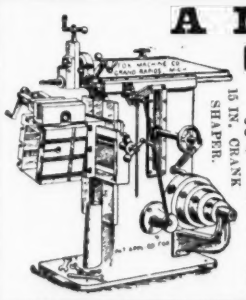

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9	1 3-8	.95
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12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
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Full set of 19		$21.60
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This Dog has a Very Heavy Base, so that if the thread wears a Heavier Screw can be substituted.

When ordering, state as above, whether a full set or a set of 12, or small set of 8. Users of these dogs prefer them to any other make.

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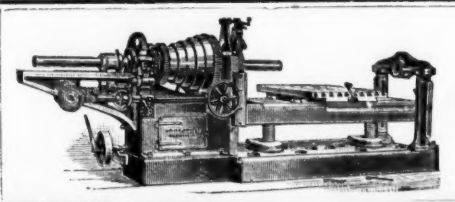

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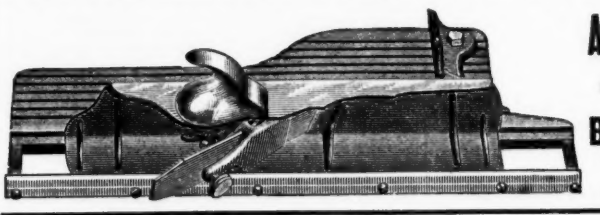

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" 4	7/8 x 1 1/2 x 9 "	@	3.80
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Wrench and 3 self-hardening steel cutters with each holder.

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18 in. x 6, 7 & 8 ft. do New & do do do
17 in. x 8 ft. do do do do
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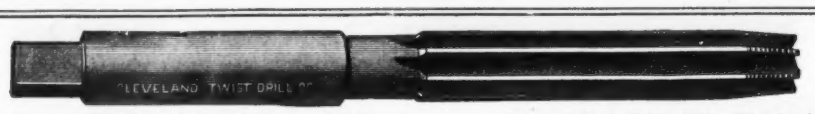

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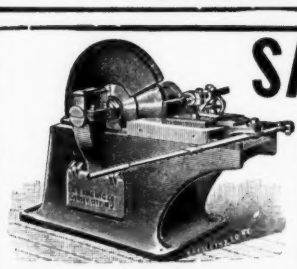

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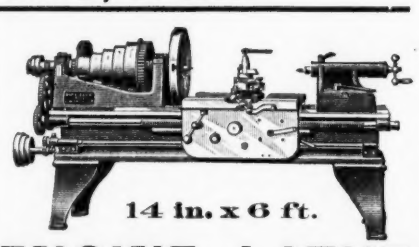

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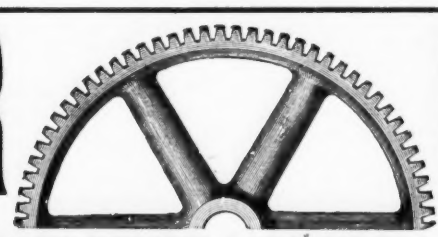

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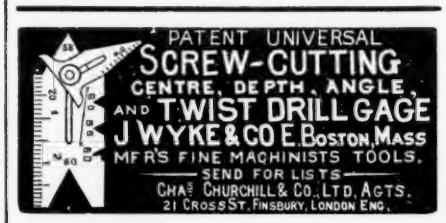
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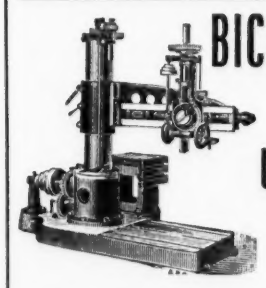

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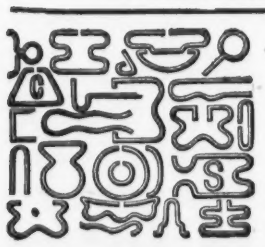

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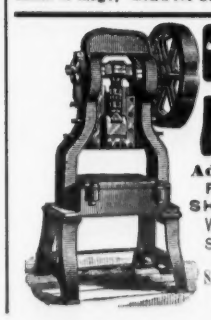

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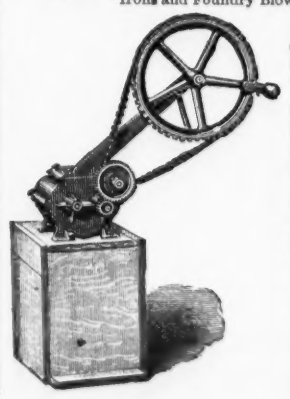

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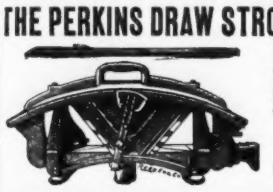

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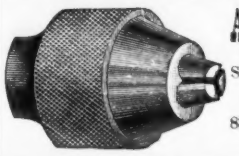

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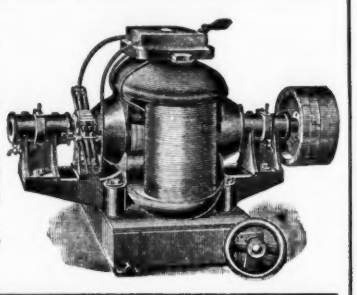

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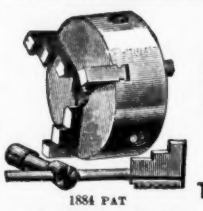

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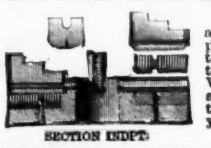

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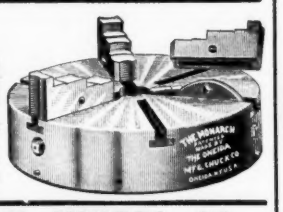

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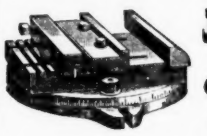

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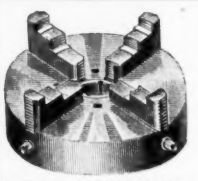

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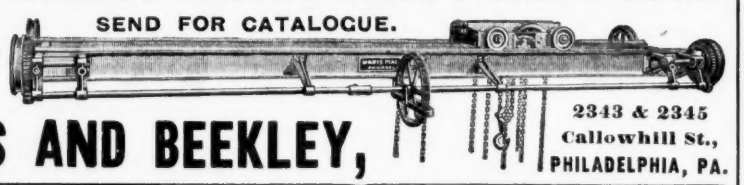

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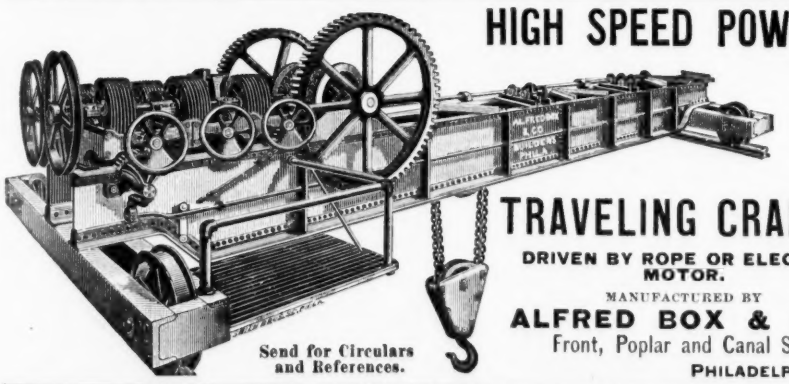

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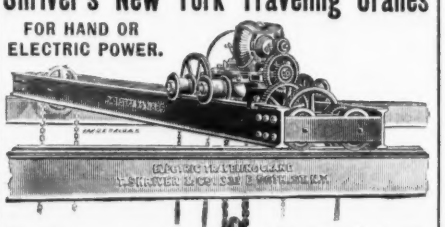

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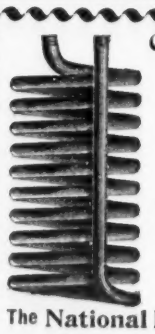

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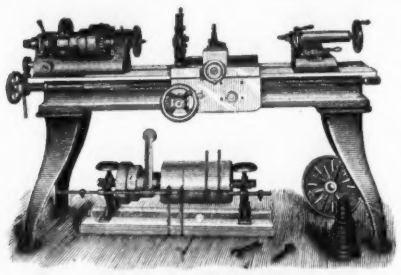

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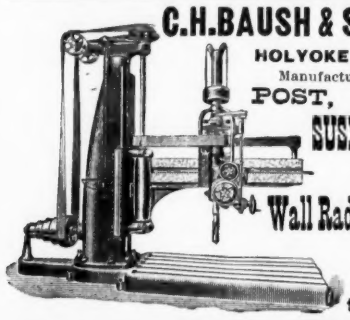

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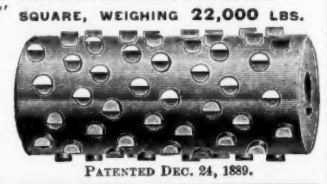

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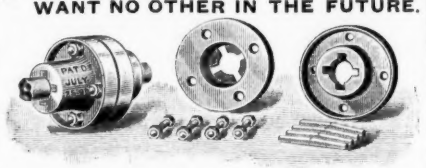

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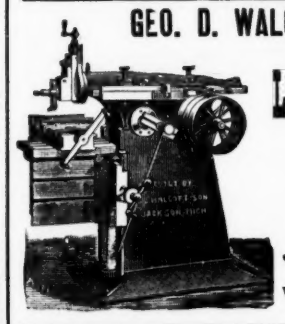

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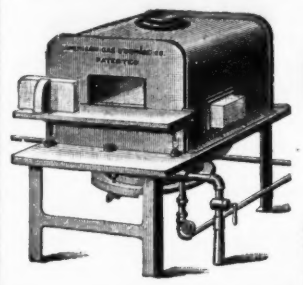

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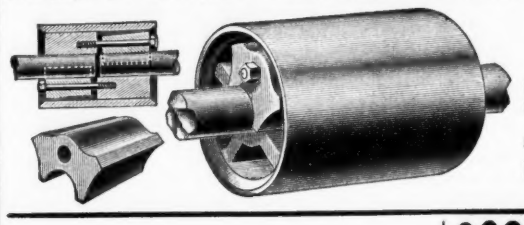

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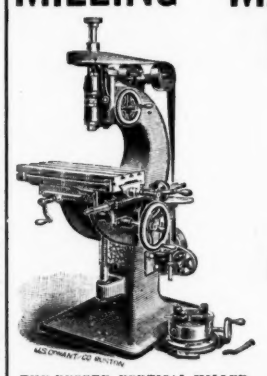

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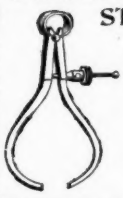

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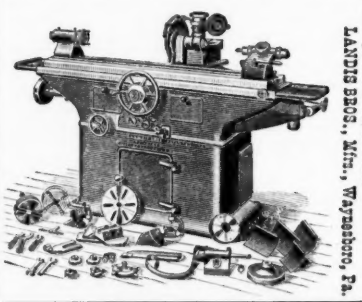

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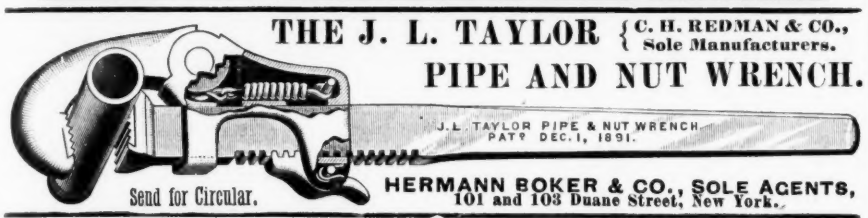

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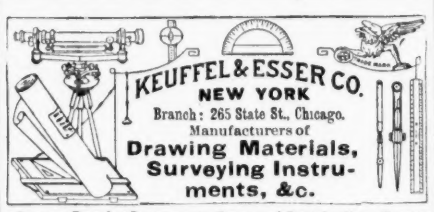

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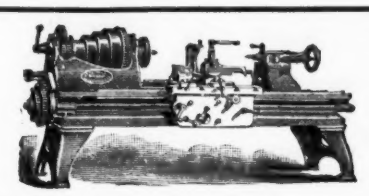

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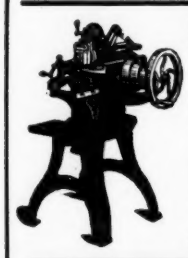

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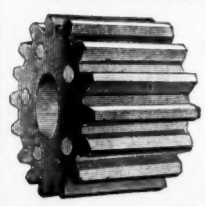

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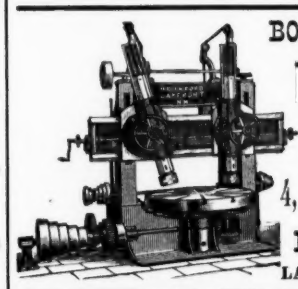

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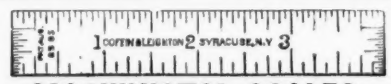

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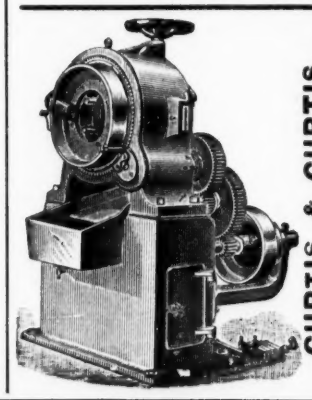

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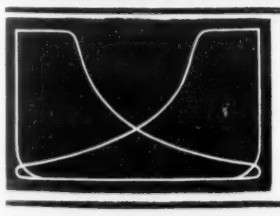

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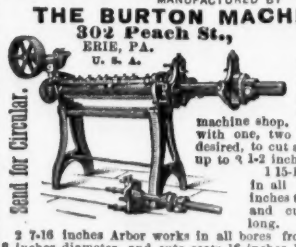

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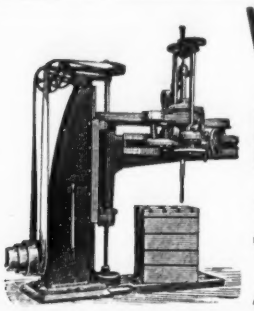

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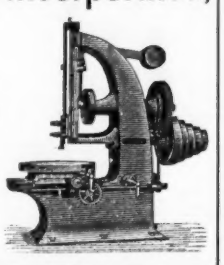

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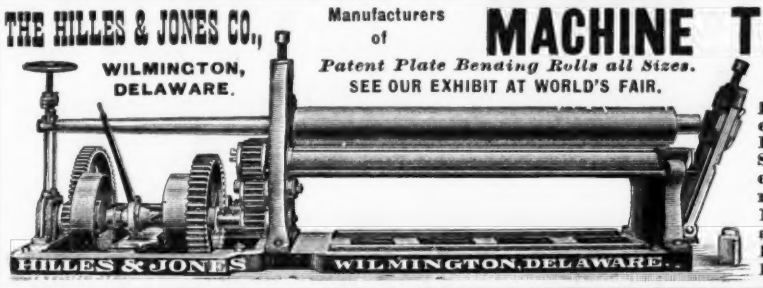

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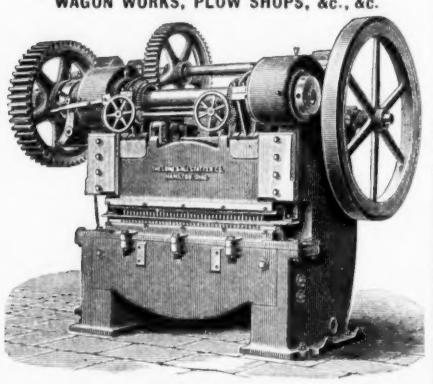

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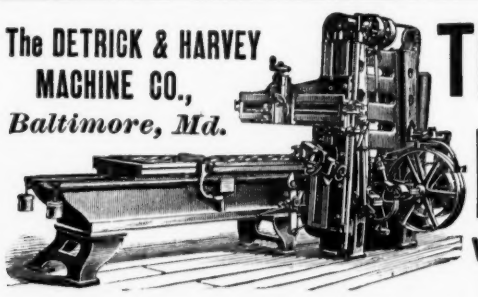

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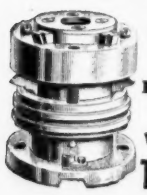

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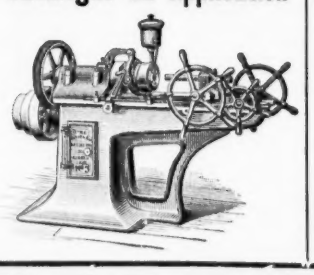

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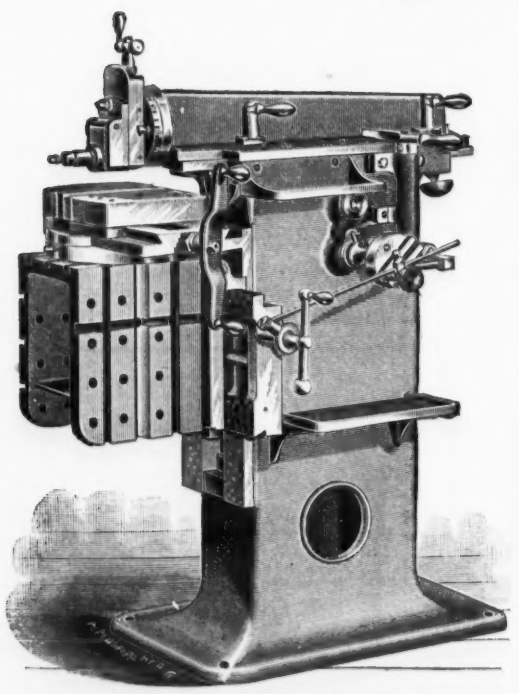

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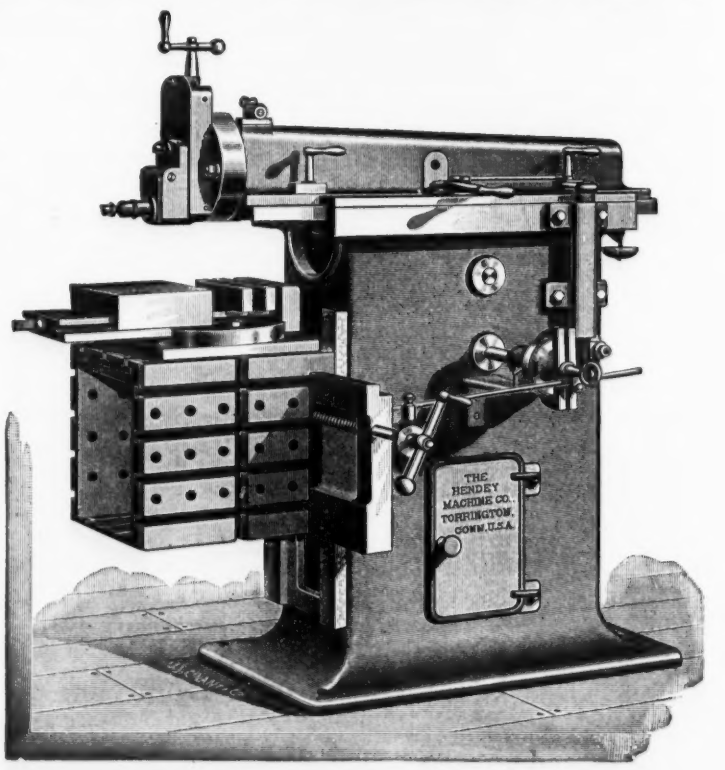

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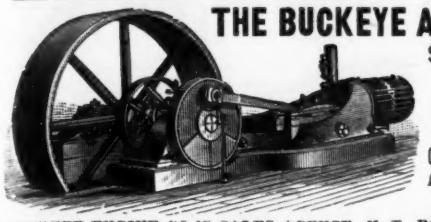

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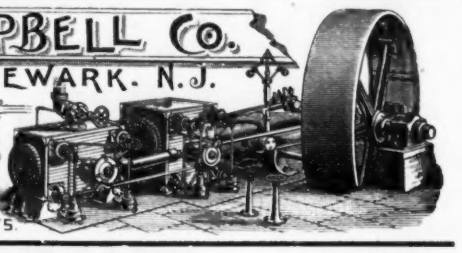

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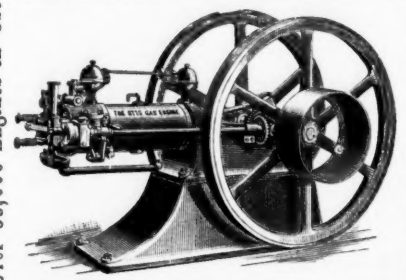

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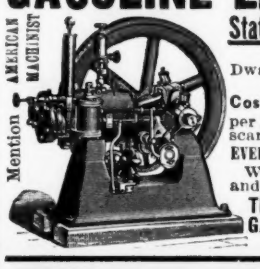

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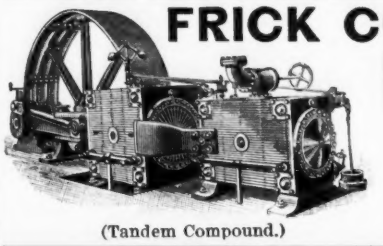

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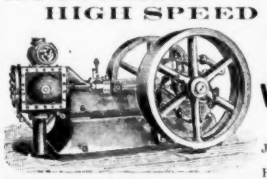

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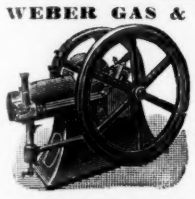

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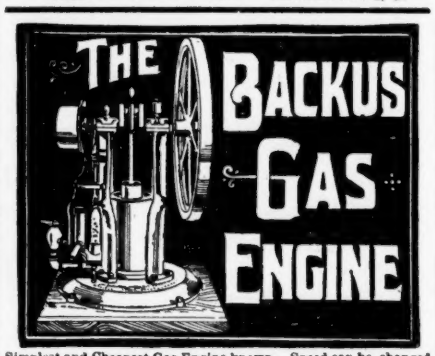

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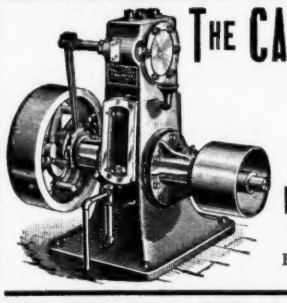

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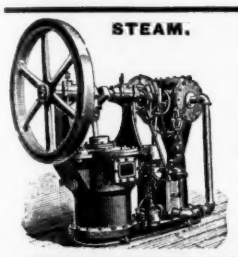

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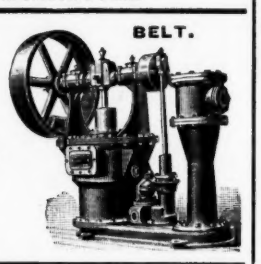

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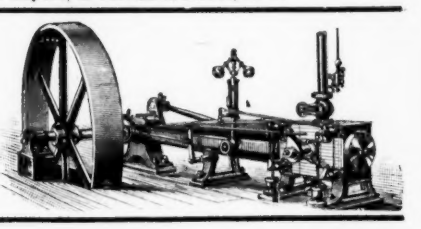

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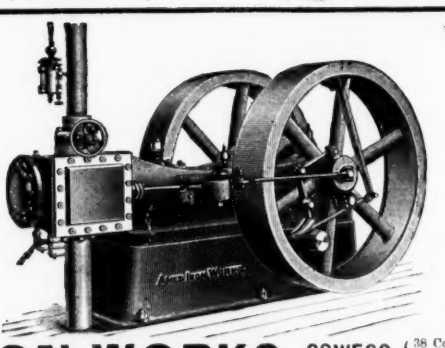

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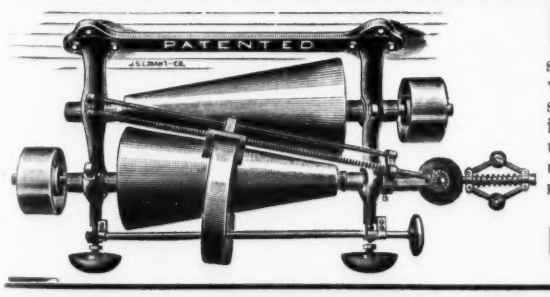

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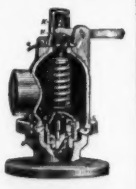

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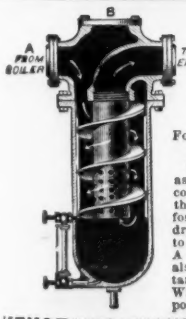

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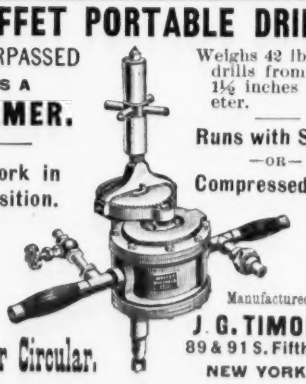

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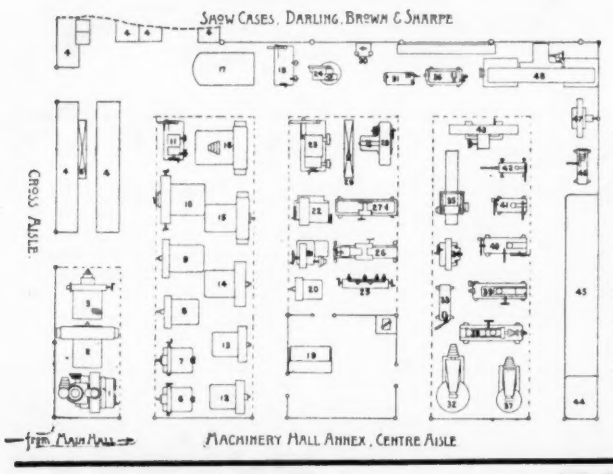

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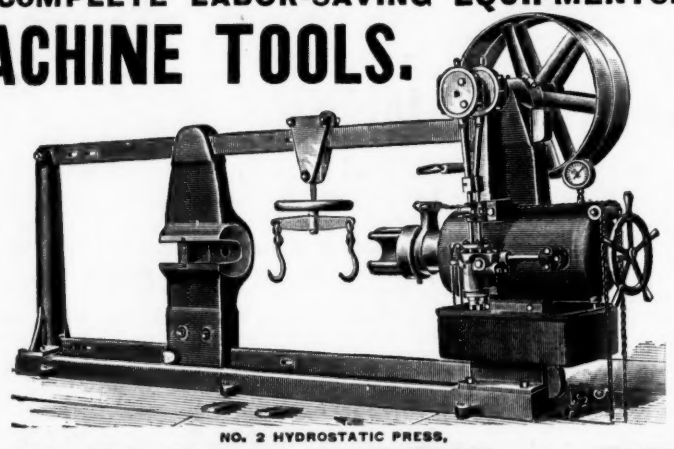

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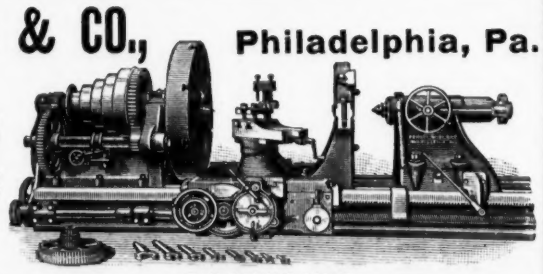

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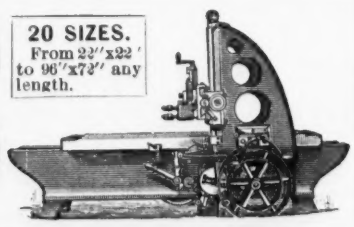

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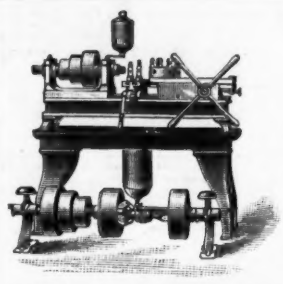

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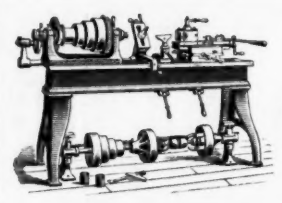

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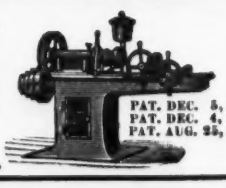

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